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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 10
OCTOBER 1, 1982

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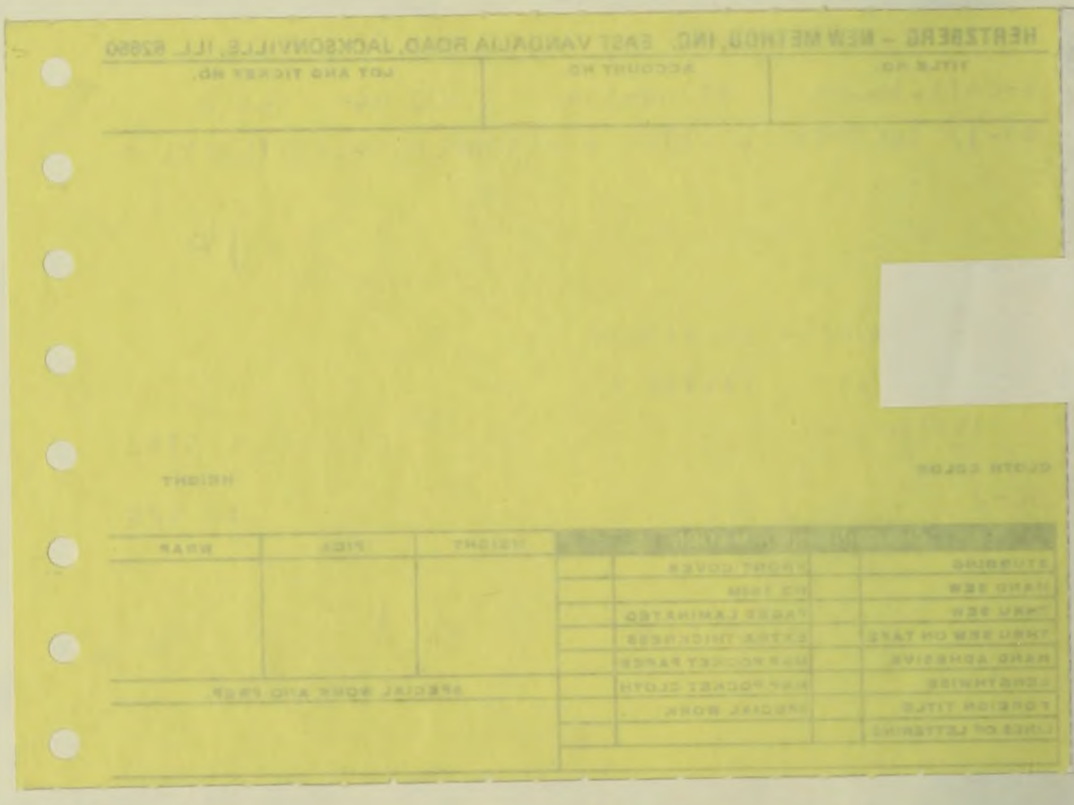

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
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VOLUME 15, NUMBER 10
OCTOBER 1, 1982

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

THE GEOTHERMAL HYDROLOGY OF WARNER VALLEY, OREGON: A RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel, and R. W. Craig.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.00. Geological Survey Professional Paper 1044-I, 1981. 47 p, 21 Fig, 1 Plate, 9 Tab, 71 Ref.

Descriptors: *Geothermal studies, *Groundwater, *Thermal water, *Thermal properties, Aquifer characteristics, Geohydrology, Geochemistry, Warm springs, Heat flow, Thermocline, Geophysics, *Oregon, *Warner Valley.

Warner Valley, a high-desert valley situated in the Basin and Range province of south-central Oregon, contains thermal waters that are currently discharged from at least 30 springs and wells. The waters originate as local meteoric water which circulates to depths of 13,000 feet or more in faults and fault intersections in Tertiary basaltic flow rocks and tuffaceous sediments. The thermal waters are of two chemical types: sodium chloride and sodium bicarbonate waters. Temperatures in the hotter sodium chloride waters are known to be as high as 127 C; the cooler sodium bicarbonate waters are highly mixed with recharge water and have temperatures in the range 20 C to 40 C. Geothermometers and mixing models indicate that temperatures of equilibration are at least 170 C for the thermal components of the hotter waters. Conductive heat flow through the valley-fill deposits is estimated to be 75 milliwatts per square meter and the normal thermal gradient in the valley may be about 40 C per kilometer, both slightly low for the Basin and Range province. The size and location of the geothermal reservoirs are unknown. If a single reservoir underlies the two principal areas of thermal discharge, total heat stored in the reservoir above a base temperature of 10 C may be about 1.6 x 10 to the 19th power joules. If, however, the thermal fluids at depth are restricted to the major boundary faults, the stored heat at high temperatures may be about 5 x 10 to the 16th power joules. Recoverable heat at lower temperatures from depths less than 1,000 feet in the valley-fill deposits may also be about 5 x 10 to the 16th power joules. (USGS)
W82-04496

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,
Geological Survey, Menlo Park, CA.
R. O. Fournier, J. M. Thompson, and C. F. Austin.
Journal of Geophysical Research, Vol 85, No B5, p 2405-2410, May 10, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Geothermal studies, *Chemical analysis, *Water analysis, *Hot springs, Water temperature, Wells, Chlorides, Groundwater reservoirs, Coso, *California.

Wellhead and downhole water samples from two wells drilled for geothermal energy exploration were sampled and analyzed in an effort to predict reservoir temperatures and fluid characteristics in still unexplored parts of the system. The first well, Coso No. 1 located at Coso hot springs in California, had been drilled to a depth of 114.3 eters. The second well, CGEH No. 1 located 3.2 kilometers to the west, had been drilled to a depth of 1477 meters. The same chloride concentration is present in hot waters entering each of the wells (about 2350 milligrams per kilogram), indicating that a body of uniformly chloride-rich hot water is present at depth in the Coso geothermal system. The maximum measured temperatures were 142 C in the Coso No. 1 well and 195 C in the CGEH No. 1 well. Cation and sulfate isotope geothermometers indicate that the reservoir feeding water to the Coso hot spring has a temperature of about 240 C to 250 C, and that the reservoir feeding the CGEH well has a temperature of about 205 C. The fumarole, acid-sulfate pool, and shallow steam well expressions of hydrothermal activity in the area give a false indication of an extensive vapor-dominated system since the upward convecting, boiling, alkaline-chloride waters do not reach the surface. The presence of a chloride-rich hot water system rather than a vapor-dominated system should be considered when interpreting geophysical data and calculating the economics of exploiting the geothermal energy resource. (Carroll-FRC)
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,
Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
K. E. Torrance, V. W. C. Chan, and D. L. Turcotte.
Journal of Geophysical Research, Vol 85, No B5, p 2554-2558, May 10, 1980. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Hydrothermal studies, *Aquifers, Thermal conductivity, Turbulent flow, *Geothermal studies, Laminar flow, Transition flow, Velocity, Mathematical models, Numerical analysis.

Numerical calculations were conducted to determine the temperature distribution resulting from the steady state hydrothermal flow of water through a smoothly curved cylindrical aquifer. The outflow water temperature was found to be closest to the ambient temperature at the base of the aquifer at intermediate flow rates. Low flow velocities resulted in the cooling of the water by conduction to the wall rock before it reached the surface, while high flow velocity did not allow the water time to be heated by conduction from the wall rock. The transition from laminar to turbulent flow was found to reduce the flow through the aquifer and the temperature of the outflow water. Outflow temperatures were generally found to be too low to explain continental hot springs. Shallow laminar hydrothermal flows were shown to be more effective in transporting heat to the surface than deeper turbulent flows. These results suggest that very shallow (less than 100 meter) hydrothermal flows of seawater in the oceanic crust may be responsible for the reduction and variability of the measured near-surface geothermal gradient. (Carroll-FRC)
W82-04744

1B. Aqueous Solutions and Suspensions

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 3C.
W82-04729

2. WATER CYCLE

2A. General

RELATION BETWEEN CURVE NUMBER AND RUNOFF COEFFICIENT,
Maryland Univ., College Park. Coll. of Engineering.
R. H. McCuen, and T. R. Bondelid.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 395-400 December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Watersheds, *Graphical methods, *Land use, *Computer models, Model studies, Graphical analysis, Mathematical studies, Mathematical models, *Runoff, Peak discharge, Hydrologic models.

Two peak discharge methods, the rational formula and the TR-55 graphic method, are based on similar input data and give similar peak discharge estimates when land use is similar. Peak discharge estimates by the rational formula are more sensitive to runoff coefficient (C) values than are TR-55 estimates to the runoff curve number (CN). The graphical method is based on the conceptual framework of the RUNOFF subroutine of the Soil conservation Service (SCS) TR-20 computer program, which should form peak discharges similar to those obtained with the rational formula. Disparities in land use values create C values that are higher than normally acceptable. This bias should be taken into account when design projects are controlled by different policies. For residential and open space land use categories, the graphical method generally provides higher peak discharge estimates than the rational method. The SCS methods, including the TR-55 graphical method, ae based on a 24 hr storm distribution and do not necessarily have to include a bias in estimating the peak discharge. (Geiger-FRC)
W82-04266

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
A. T. Marinos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 388-394, December, 1981. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Mathematical equations, *Drainage, *Precipitation intensity, *Flow profiles, Mathematical models, Darcys law, Youngs modulus, Water table, *Porosity.

Young's inequality for steady drainage through a porous strip contained between two parallel ditches is useful for relating the height of the water table at its center, the precipitation intensity, the ditch spacing, and the level of permanent water horizon. An extension of Young's inequality to three-dimensional flow is presented which may be applied to calculate the limits on precipitation intensity for steady flows so that the maximum height of the water will not exceed a prescribed value. The equations for calculating these bounds take on closed type formulas when the steady drainage takes place through regular (rectangular) cross sections and the precipitation intensity is such that a formal solution of the partial differential equation is possible. (Geiger-FRC)
W82-04267

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
R. Charbonneau, J.-P. Lardeau, and C. Obled.
Hydrological Sciences Bulletin, Vol 26, No 4, p 345-361, December, 1981. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Hydrologic models, *Snowmelt, *Hydrologic cycle, *Catchment areas, Model studies, Evapotranspiration, Evaporation, Energy, Air temperature, Physiographic balance, Drainage area, Precipitation, Snow, Mountains, *Durance River basin, *French Alps.

Three snowmelt and evapotranspiration models for a high mountain drainage basin of the Durance River in the French Alps were developed and compared. The Durance model was specifically designed for the basin and used a refined description of the physiographic features and snowmelt routine based on energy budgets at 12 hr intervals. The HSP general purpose hydrological model was partially standardized and showed the best four-year adjustment due to its large number of degrees of freedom. An intermediate model kept all the parameter values of the HSP model, but did not benefit from a heat budget component. This modified HSP model receives air temperature values from a main program which has been shown to systematically underestimate the maximum temperature which influences snowmelt. The ready-made models took almost as long to set up and adjust as the Durance model. Major errors in calculations did not occur in the modelling of the hydrological cycle but rather in peripheral parameters dealing with data estimation or extrapolation.

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It was suggested that standardized procedures for the estimation of missing model data be avoided and replaced by objective analyses of precipitation, snow cover and temperature fields of the drainage basin. (Geiger-(FRC)
W82-04303

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 385-388, December, 1981. 1 Fig, 10 Ref.

Descriptors: *Graphical methods, *Watersheds, *Mathematical models, *Storm runoff, *Discharge measurement, Graphical analysis, Runoff, Model studies, Runoff, Precipitation, Mathematical equations, Mathematical studies, *Channel morphology.

The graphical solution for relative discharge allows rapid estimation of runoff changes due to watershed modifications and visual evaluation of the sensitivity of runoff change to the Soil Conservation Service curve number (CN) modifications and storm precipitation. An equation for relative runoff may be used for a more accurate calculation; however, an analysis based on curve numbers should be regarded as only an approximate solution. The relative runoff equation may be solved by graphical methods. Vertical and horizontal nomographs are used to intersect two specific sections of the rectangular chart, and the curve corresponding to the Cartesian coordinate defined by these two intersections represents the relative runoff. Graphical analysis of relative change provides a pragmatic basis for anticipating runoff modification for problems where actual discharge can be measured or estimated by alternative methods. (Geiger-FRC)
W82-04307

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-04308

THE GENERAL HYDROLOGIC SYSTEM MODEL,
Mississippi State Univ., Mississippi State. Dept. of Mathematics.
R. C. McCann, and V. P. Singh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, 1581-1592, December, 1981. 3 Fig, 14 Ref.

Descriptors: *Hydrographs, *Storm runoff, *Hydrologic models, General Hydrologic System model, Model studies, Runoff, Rainfall-runoff relationships, Excess rainfall, Chow and Kulandaiswamy model.

Improvements and simplifications are suggested for Chow and Kulandaiswamy's General Hydrologic System model. The problem of negative instantaneous unit hydrographs, arising from the inconsistencies in the derivations and initial conditions, was solved by assuming an instant unit hydrograph of zero at zero time. This caused coefficients associated with derivatives of excess rainfall to vanish. (Cassar-FRC)
W82-04314

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. L. Nieber, and M. F. Walter.
Water Resources Research, Vol 17, No 6, p 1722-1730, December, 1981. 12 Fig, 23 Ref.

Descriptors: *Soil water, *Slopes, *Infiltration, Numerical analysis, Hydrographs, Flumes, Rainfall infiltration, Capillarity.

The two-dimensional flow of soil moisture under the conditions of rainfall infiltration was studied in a hillslope soil moisture flow laboratory model composed of a flume (3.66 x 0.58 x 0.108 m) filled with sand. Experimental results, expressed as hydraulic head fields and runoff hydrographs, agreed well with results from a numerical solution after the effects of capillary hysteresis were incorporated into the numerical solution. Without considering the capillary hysteresis the numerically simulated hydrograph lagged behind the experimental hydrograph to a significant degree. the numerical technique was derived from a finite element-finite difference solution of the Richards equation. (Cassar-FRC)
W82-04333

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
D. L. Murray, and A. H. M. Gorgens.
Water SA, Vol 7, No 4, p 223-233, October, 1981. 6 Fig, 6 Tab, 16 Ref.

Descriptors: *Storm runoff, *Rainstorms, *Hydrographs, *Semiarid lands, Rainfall-runoff relationships, Statistical analysis, Ecca River, Grahamstown, *South Africa, Runoff, Rainfall intensity, Evaporation, Streamflow, Antecedent moisture, Peak flow.

A statistical analysis of storm rainfall and streamflow data (1975-1979) from 3 semiarid catchments in the Ecca River region, South Africa, produced preliminary equations for predicting storm hydrograph characteristics. The best index of catchment wetness at the beginning of a storm was generally the seven-day antecedent rainfall. Storm flow volume was predicted using seven-day antecedent rainfall and storm rainfall. Storm flow peak and storm flow duration were obtained from predicted storm flow volume. Independent variables considered in this study were storm rainfall, rainfall duration, maximum intensity of rainfall, antecedent flow, and antecedent rainfall and moisture indices calculated by accumulating rainfall and potential evaporation over varying periods prior to storms. (Cassar-FRC)
W82-04339

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien, and W. S. Motts.
Water Resources Bulletin, Vol 16, No 5, p 785-789, October, 1980. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Wetlands, *Classification, *Land use, *Groundwater potential, Geohydrology, Geology, Topography, Geomorphology, Water quality, Aquifers, Hydrology.

Since wetlands vary according to geologic, hydrologic and topographic settings, a wetland classification based on these factors which modify hydrologic response is proposed to provide a good framework for evaluation of wetland research in relation to land use planning. Wetlands affect the potential for groundwater development in wetland dominated basin, modify the character of runoff from a basin and influence the discharge/recharge relationship with the underlying aquifer. Some geologic and hydrologic factors which might allow distinction between wetlands include the character and thinkness of surficial materials, bedrock type, hydrologic position, permeability of the organic layer, transmissivity, water quality, aquifer structure, groundwater outflows and depth of standing water. Some distinguishing topographic features of wetlands are position in the drainage basin, relative size, and absolute size of wetlands. Application of the proposed classification scheme to wetlands in the northeastern United States produced two realistic geologic types that could be expected to be encountered. Matrices of these two types produced 25 categories of wetlands, 13 of which are common types. These types should be further tested to define their hydrologic function in this classification scheme. (Geiger-FRC)
W82-04439

ANALYSIS OF DETENTION BASIN SYSTEMS,
Monash Univ., Clayton (Australia).
R. G. Mein.
Water Resources Bulletin, Vol 16, No 5, p 824-829, October, 1980. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Mathematical models, *Detention reservoirs, *Design criteria, *Flood peak, *Flood-control storage, Hydrologic models, Model studies, Catchment basins, Flood hydrographs, Storm runoff, Flood routing, Simulation analysis, Mathematical studies.

Simple procedures of designing detention basins to reduce peak flows on rivers and streams are often limited in scope. A more complicated routing model is described, and its application to an urban basin system at Gardiners Creek, Australia is examined. The model computes design inflow hydrographs and routes flow downstream to the next point of interest. The catchment is divided into subcatchments along watershed lines, excess rainfall is calculated from the temporal pattern of the nearest recording rain gauge, and the depth is obtained from the isohyetal map of the storm event. Catchment storage effects are simulated by routing flows between subcatchments through simple nonlinear storage elements. The present model was found suitable for examining basins in series or in parallel. Although it seems unlikely that the addition of a basin would increase flood peaks downstream to any significant extent, it still may be possible for a particular combination of basins to have this effect. It is therefore suggested that multibasin systems be fully investigated under various storm events to assess the individual contribution of each basin to flood mitigation. (Geiger-FRC)
W82-04444

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, R. H. McCuen, and A. Rango.
Water Resources Bulletin, Vol 16, No 5, p 914-920, October, 1980. 4 Tab, 8 Ref.

Descriptors: *Snowmelt, *Runoff-forecasting, *Model studies, Mathematical studies, Water supply, Remote sensing, Hydrologic models, Comparison studies.

Available snowmelt models were tested for accuracy on a single watershed using the same data base. Specific analyses were made for determining the value of Landsat derived snow covered area (SCA) data in the various runoff prediction models; to investigate the value of subdividing the watershed into smaller, more homogeneous areas; to determine the effect of delays in data collection such as that which might occur in the compilation and analysis of Landsat data; to evaluate the accuracy of forecasts based solely on SCA measurements; and to determine the length of record required for model calibration. Models tested include the Regression model, the Water Balance model, and the Martinec model. Accuracy of the Tangborn model and the regression models was greater if the test data fell within the range of calibration data rather than outside. Regression models were significantly more accurate for forecasts of 60 days or more than for shorter periods. The Tangborn model was more accurate for forecasts of 90 days or more. The Martinec model was more accurate for forecasts of 1, 2, 3, 5, 10, or 15 days. Accuracy of long term models was independent of forecast data. The short term models were least accurate for forecast periods in late May and early June. The Martinec model was the best of those tested for one and two day forecasts. Regression models were roughly equal in accuracy. Spatial separation of the watershed by elevation zones did not improve the accuracy of the Martinec model in the Kings River basin. Delays in data collection of more than one day may sig-

nificantly lessen the accuracy of the Martinec model. (Baker-FRC)
W82-04452

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),
Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
V. D. Hoang, and B. Robert.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 433-441, 1981. 4 Fig, 3 Tab, 5 Ref. English summary.

Descriptors: *Hydrologic models, *Lakes, *Forecasting, Prediction, Water levels, *Lake Memphremagog, *Quebec, Flood control, Snowmelt, Runoff, Watersheds, *Inflow forecasting.

Water inflow forecasts are being designed for some Quebec watersheds for the purposes of environmental protection and to fulfill international agreements. Accurate assessment of runoff during the spring thaw and periods of heavy rain was necessary for Lake Memphremagog near Magog, Quebec, in view of the low discharge capacity at the outlet of the lake and the obligation to regulate water levels. A hydrometeorologic model of the deterministic type, the SSARR (streamflow synthesis and reservoir regulation) model, was selected. This model makes it possible to calculate the snowmelt based on daily temperature and precipitation values, whereas the other possibility, the Ohio-Stanford model, requires a knowledge of numerous physical parameters requiring complex measurements. The SSARR model incorporates sub-models of the watershed, the river drainage, and the lake reservoir, plus a forecasting model. The resulting model was calibrated using data from the Black River for 1971-1973, then verified with data from 1974 and 1975. The error in the observed flow compared to the calculated flow was estimated using the criterion of volume, the point criterion, and the final criterion. Predictive application of this model in 1979 gave highly encouraging results, with an error of about 16%. Further improvements are desired to reduce the error to 10%, but the information already available will permit adequate flood warning for downstream residents plus systematic operation of the outlet dam. (Carroll-FRC)
W82-04459

REGIONAL HYDROLOGIC MODELS FOR CLIMATOLOGY: AN APPLICATION TO THREE WISCONSIN WATERSHEDS,
Wisconsin Univ.-Madison.
D. R. Clark.
PhD Thesis, May, 1981. 106 p, 19 Fig, 17 Tab, 35 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-17508.

Descriptors: *Watersheds, *Hydrologic models, *Seasonal variation, *Evapotranspiration, Runoff, Drainage, Recharge, Soil moisture retention, *Climatology, *Wisconsin.

Two hydrologic models are applied to three watersheds in south central Wisconsin over a thirty year period. Although in the same climatic region, the three watersheds have different hydrologic responses due to their different basin characteristics. The two models are designed for the study of seasonal interactions between external climatic factors and regional hydrologic responses. Input data consists of monthly rainfall, snowmelt, absorbed solar radiation, frost depth and an empirical vegetation seasonality index. Evapotranspiration is parameterized in terms of absorbed solar radiation, a vegetation seasonality index, and moisture storage. Parameterization of runoff and drainage between storages includes the effect of soil freeze and moisture storage. Model parameter values were obtained by calibration of model runoff to observed streamflow. Model storage levels were compared to water table observations in one watershed. Sensitivity of the calibrations was tested by a series of Monte-Carlo experiments using randomly perturbed input data, and by parameter sensitivity tests. The two storage model is found to simulate streamflow just as well as the three-storage model. Normal spring ground water recharge is reduced or absent when preceding fall precipitation fails to replenish summer soil moisture losses, or scant snowcover permits deep winter soil freeze. Major recharge episodes result from consecutive months of excessive precipitation or snowmelt, but not from an isolated high-input month. (Sinha-OEIS)
W82-04483

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
E. L. Bolke, and J. A. Skrivan.
Geological Survey Open-File Report 81-425 (WRI), 1981. 34 p, 14 Fig, 2 Tab, 8 Ref.

Descriptors: *Computer models, *Aquifers, *Surface-groundwater relations, *Water use, Simulation analysis, Model studies, Water demand, Hydrologic budget, Irrigation, Streamflow, Wells, Water levels fluctuations, Groundwater movement, Hydraulic conductivity, *Washington, *Yakima Indian Reservation, Yakima River.

Increasing demands for irrigating additional lands and proposals to divert water from the Yakima River by water users downstream from the Yakima Indian Reservation have made an accounting of water availability important for present-day water management in the Toppenish Creek basin. A digital model was constructed and calibrated for the Toppenish alluvial aquifer to help fulfill this need. The average difference between observed and model-calculated aquifer heads was about 4 feet. Results of model analysis show that the net gain from the Yakima River to the aquifer is 90 cubic feet per second, and the net loss from the aquifer to Toppenish Creek is 137 cubic feet per second. Water-level declines of about 5 feet were calculated for an area near Toppenish in response to a hypothetical tenfold increase in 1974 pumping rates. (USGS)
W82-04514

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W82-04535

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W82-04552

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04646

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,
Sir William Halcrow and Partners, London (England).
M. J. Hall.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 37-50, March, 1981. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Urbanization, *Hydrographs, *Streamflow forecasting, Land use, Rainfall-runoff relationships, Paving, Runoff, *Urban runoff, Excess rainfall, England.

A method for quantifying changes in flow regimes caused by urbanization was developed. Unit hydrographs corresponding to a common duration for catchments in different stages of urban growth were correlated with catchment characteristics such as degree of urban development. This procedure was used with data from several areas in England to derive a dimensionless one-hour unit hydrograph. The scaling parameter for the hydrograph was expressed as a function of the basin ratio and the percentage of impervious area. (Cassar-FRC)
W82-04683

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
S. M. Novkov, and J. S. Goncharova.
Hydrological Sciences Bulletin, Vol 26, No 4, p 393-398, December, 1981. 10 Ref.

Descriptors: *Hydrologic budgets, Evaporation, Swamps, *River basins, *Drainage effects, *Hydrologic models, *Land management, Groundwater depletion, Predictions, Marshes, Wetlands, Catchment areas, Runoff, Model studies, Simulation analysis, Mathematical studies, Drainage.

Methods for predicting the annual water balance of a large river basin after drainage are considered. The precipitation of the model situations was assumed to be constant and unaffected by drainage. Drainage in the improved basins caused the annual runoff to decrease groundwater and swamp water resources, leading to changes in evaporation patterns. Reductions in groundwater resources were calculated for each percent of the basin drained, based on experimental data on the hydrophysical properties of mineral soils and subsoils and peats. Using this method, reductions in groundwater were taken into account, while changes in runoff were predicted. Evaporation changes were calculated from the difference between the potential evaporation (maximum possible evaporation) from cultivated sections and that from undisturbed swamps. (Geiger-FRC)
W82-04721

2B. Precipitation

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,
Ohio State Univ. Columbus. Dept. of Electrical Engineering.
T. A. Seliga, V. N. Bringi, and H. H. Al-Khatib.
Journal of Applied Meteorology, Volume 20, No 11, p 1362-1368, November, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Remote sensing, *Radar, *Rainfall, Raingages, Rainfall distribution, *Rainfall rate, Mathematical studies, Rainstorms, Chicago, Illinois, Measuring instruments, Calibrations, Spatial distribution.

Areal measurements of rainfall rate obtained by the differential reflectivity Z-DR technique were compared with raingage measurements and conventional radar measurements for two 550 sq km areas in the Chicago region over time intervals of about 1 hr. Z-DR is defined as ten times the logarithm of the quotient of the reflectivity at horizontal polarization divided by the reflectivity at vertical polarization. A relativecalibration between horizontally and vertically polarized reflectivities was done by pointing the radar vertically and comparing reflectivity factors at orthogonal polarizations. On the test day rainfall occurred over a wide area and lasted for several hours. Excellent agreement between radar Z-DR and raingage measurements was found; the Z-DR results were considerably better than those from two Z-R (reflectivity-rainfall rate) relationships, one of which was calibrated with 20 minutes of gage measurements. The University of Chicago-Illinois State Water Survey radar used had slow polarization switching, and significant improvements in the differential reflectivity measurements would be obtained by pulse-to-pulse switching of polarization. Over one of the 550 sq km areas the Z-DR method measured 86%

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of the rainfall recorded on 26 raingages during an observation period of 80 min, and over the other, 117% of the rainfall recorded on 27 raingages was obtained during a 40 min period. (Carroll-FRC)
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,
Bureau of Reclamation, Denver, CO.
G. E. Klazura.
Journal of Applied Metorology, Vol 20, No 11, p 1376-1380, November, 1981. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, *Rainfall, *Rain gages, *Radar, Rainfall distribution, Rainfall intensity, Mathematical studies, Convective precipitation, Rainstorms, Montana, Calibrations, Spatial distributions.

Attempts have been made to achieve optimal estimates of precipitation by combining radar and raingage data, essentially using raingages to calibrate the radar measurements. One method of calibration is that of computing an adjusted radar-rainfall field by means of the G/R ratio (gage amount divided by the sum of radar-derived rainfall throughout a rainfall event). A study was conducted to examine how much the G/R ratios would vary in an actual high rainfall-rate gradient situation considering the location and size of the radar contributing area, computation of radar-estimated rainfall using maximum, average or integrated values, and radar reflectivity factor threshold for average and integrated values. Data examined were collected on a convective shower day, June 6, 1976 at Miles city, Montana. Differences exceeded a factor of 6 and 3 were observed for individual gages and for the mean of 17 gages, respectively. Conclusions were incompleted because of the limited data set analyzed and the absence of positive truth, i.e., knowledge of the location of the most representative radar bin. Withouth a comparative analysis it was impossible to know whether improvements in G/R values will produce better rainfall estimates. If wind information is available at each gage location it may be possible to make a reverse trajectory analysis to identify the most representative radar bin for each averaging time period. If isolation of the representative radar bin is not possible, it is probably best to use either the averaging or integrating method with a reflectivity factor threshold, allowing for precipitation drift and evaporation. (Carroll-FRC)
W82-04265

HYDROCLIMATOLOGICAL CHARACTERISTICS OF ISOLATED SEVERE RAINSTORMS,
Illinois State Water Survey, Urbana.
S. A. Changnon Jr., and J. L. Vogel.
Water Resources Research, Vol 17, No 6, p 1694-1700, December, 1981. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Rainfall intensity, *Weather forecasting, *Storms, Precipitation intensity, Flood forecasting, Flash floods, Local precipitation, *Illinois, Rainstorms, Rainfall distribution, Rain gages, Climatology.

Intense, very localized severe rainstorms were studied in Illinois, where four dense rain gage networks produced data from 32 storms in the warm season, May-September, 1955-1978. These storms, responsible for flash floods with resulting erosion and water pollution, generally last 3-12 hours, affect less than 1000 sq km, and have 1 to 4 hour rainfall totals in excess of 7.5 cm. About 40 such storms occur over Illinois (145,000 sq km) each warm season. The storm of July 30-31, 1979, over central Illinois is described in detail. The storm began at 1445 CDT and ended by 2100. Over 17.8 cm of rain fell, with the greatest intensity within 4 hours, at a station near Urbana. The core of this storm was extremely small. Only 8 sq km received a depth of 18 cm or more, and 960 sq km received 5 cm or more. The storm occurred in a maritime tropical air mass and was not associated with frontal activity. Prior to the start of the storm the surface dewpoint temperature was greater than normal (23-26 C), the atmosphere was unstable, precipitable water from the surface to 400 mb was greater than average (3.97 cm), and wind speeds increased with height from 7.7 mps at 850 mb to 12.9 mps at 500 mb. Three distinct precipitation systems with a total of nine rain cells moved over the region. Radar and satellite photos can be used to detect the development of localized intense rainstorms. Characteristics of this type of storms--stationary multicelled in nature with strong preference for afternoon development--are keys for detection and local flood warnings. (Cassar-FRC)
W82-04336

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
F. H. Quinn.
Water Resources Research, Vol 17, No 6, p 1619-1624, December, 1981. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Water level fluctuations, *Seasonal variation, *Water management, *Great Lakes, *Precipitation, Climatic data, Lakes, Lake shores, Erosion, Statistical analysis.

Two distinct precipitation regimes were identified by statistical analysis of annual precipitation data in the Great Lakes basin from 1854-1979. Since the late 1930's the precipitation regime has been relatively wet, with an increase in average annual precipitation of 50 mm per year, due primarily to greater amounts of spring and summer precipitation. A dry period existed from the mid- 1880's to about 1940. Prior to 1880 the sketchy records indicate that precipitation was similar to the present. Recorded levels of Michigan-Huron-Erie corresponded with the precipitation through the years of interest. In addition, annual flows of the Niagara River from 1860 to the present show above average flows before 1890 and after 1940, with below average flows in the interim years. This may mean that the present relatively wet conditions are the normal climate for the basin. If this persists, water managers must deal with problems such as poor performance of the current Great Lakes regulation plans, continuing erosion due to high lake levels, and revisions in water supply forecasting techniques to account for higher precipitation. (Cassar-FRC)
W82-04431

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04452

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
D. G. DeCoursey, W. L. Chameides, J. McQuigg, M. H. Frere, and A. D. Nicks.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981, p 85-112, 21 Fig, 1 Tab, 54 Ref.

Descriptors: *Thunerstorms, *Forest management, *Agriculture, Precipitation, *Water pollution, Nitrogen fixation, Lightning, Flooding, Soil erosion, Water pollution, Sediments, Hail, Nutrients, Pesticides, Channel erosion, Gully erosion, *Storm runoff, Sediment transport, Overland flow.

Precipitation can be divided into two general types: that associated with weak ascending air currents on a scale of about 1,000 km, and that associated with rapid overturning of a local air mass with large variability of air motion and precipitation on a scale of tens of kilometers. The showers and thunderstorms identified with the second type can be beneficial or harmful to agriculture. Beneficial effects of thunderstorms include: moisture for crop production; farm and ranch water supply; irrigation water supply; and nitrogen fixation by lightning. Harmful effects of thunderstorms can be grouped into four major areas: damage directly to rangeland and crops by hail, flooding, or wetting an air-dried product; erosion of cropland caused by excessive runoff rates; leaching of plant nutrients from the soil profile; polluting surface waters; flooding of cropland along major streams. Heavy rain, usually associated with thunder, produces large volumes of surface runoff, with resulting loss of soil and associated pollutants, including sediment, nutrients, and pesticides. Overbank flooding on a typical stream is estimated to occur once in 1 to 4 years. Quite often, flooded areas include the most productive soils planted with high-yield crops. Erosion of stream channels and gullies indirectly resulting from heavy rains is a major problem. (Moore-SRC)
W82-04617

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
For primary bibliographic entry see Field 7B.
W82-04647

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,
Indo-British Betwa Groundwater Project, Bhopal (India).
D. K. Das, G. K. Burman, and A. L. Kidwai.
Mausam, Vol 32, No 3, p 221-228, July, 1981. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Rain, *Chemical composition, *Monsoons, *India, Bicarbonates, Calcium, Salinity.

Monsoon rainwater samples collected at Bhopal, India, during June-August 1977 and April-September 1978 contained variable levels of chemical constituents. Bicarbonate and calcium were the predominant anion and cation, with concentration ranges of 2.4-32.0 (average 10.0) mg per liter and 0.6-12.0 (average 3.0) mg per liter, respectively. pH ranged from 6.0 to 7.2, average 6.2. EC varied from 15 to 80 micromhos per cm at 25 C. Concentration ranges of other constituents were as follows (in mg per liter): chloride, 0.9-9.4 (average 3.4); sulfate, 1.2-5.8 (average 3.2); nitrate, 0.12-0.88 (average 0.5); Mg, 0.16-4.3 (average 0.81); Na, 0.08-4.3 (average, 0.80); K, 0.01-1.2 (average 0.16); boron, 0.002-0.068; fluoride, 0.1; Fe, 0.01-0.08; and silica, 0.4-2.8. Ranges of trace metals were as follows (in ppb): Sr, 1-30; Zn, 10-76; Mn, 1-5; Cu, 1-8. No Li or Ni was detected. It is believed that most of the chemical constituents in the monsoon rainwater were from non-marine sources. (Cassar-FRC)
W82-04666

USEFULNESS OF MONTHLY RAINFALL NORMALS IN AGROCLIMATIC MAPPING,
Meteorological Office, Poona (India).
R. R. Kelkar.
Mausam, Vol 32, No 2, p 181-188, April, 1981. 7 Fig, 16 Ref.

Descriptors: *Rainfall distribution, *Mapping, *Planting management, Agriculture, *India, Crops, Planning, Seasonal variation, Meteorological data collection.

Several attempts to obtain rainfall data more appropriate than monthly rainfall data for agricultural planning in India are described. Most data and maps apply to the state of Maharashtra. The sowing rains concept is based on the dates of commencement of sowing rains (CSR), which are defined as a spell of at least 25 mm of rain in 7 days with 1 mm or more on any 5 of these 7 days. Raman applied this method to maps showing CSR dates for Maharashtra. Also indicated are standard deviation of CSR, average interval between CSR and next wet spell, and median CSR distribution. This information shows areas where likelihood of short growing seasons and necessity of second

sowings are high. Probability analysis indicates the probability of rainfall being adequate in a given week. India's total annual rainfall does not vary widely in spite of droughts and floods. Therefore the coefficient of variation has been used to indicate monthly rainfall patterns in stations throughout India. A simple method, an extension of the National Commission on Agriculture's mapping technique, involves only monthly normals of rainfall and number of rainy days. This accounts for large amounts of rainfall on isolated occasions when much water is lost as runoff. Maps prepared using this technique indicate optimum time of sowings, good locations for surface runoff ponds, places for early-maturing varieties, and sites for no karif planting but early rabi planting. (Cassar-FRC)
W82-04668

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2K.
W82-04669

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,
Flood Meteorological Office (India).
A. Lahiri.
Mausam, Vol 32, No 1, p 41-44, January, 1981. 2 Fig, 7 Tab, 8 Ref.

Descriptors: *Rainfall distribution, *Synoptic analysis, *Flood forecasting, Weather forecasting, Forecasting, *Teesta River, *India, Monsoons, Rainfall-runoff relationships, Mountains, Precipitation.

Heavy rain producing synoptic systems were associated with intervals of average precipitation to produce quantitative precipitation forecasting in the 80% mountainous Teesta River catchment, India. The region is affected by six categories of heavy rain producing synoptic systems, classified according to the position of the low pressure areas or monsoons. The frequency distributions of floods occurring from precipitation amounts of 11-25, 26-50, and > 51 mm in the six categories range from 2 to 19, with a total of 46. Frequency distributions of heavy average areal precipitation for the same groups of precipitation amounts in the 5 months of the flood season are as follows: June, 113, July, 122, August, 105, September, 70, and October, 13. June, July, and August are the most flood prone months, partly because heavy rains are not evenly distributed. In September and October heavy rains are more evenly distributed. (Cassar-FRC)
W82-04670

EVIDENCE OF URBAN AND LAKE INFLUENCES ON PRECIPITATION IN THE CHICAGO AREA,
State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Journal of Applied Meteorology, Vol 19, No 10, p 1137-1159, October, 1980. 17 Fig, 11 Tab, 20 Ref.

Descriptors: *Precipitation, *Urban areas, *Lakes, *Rainfall, Areal precipitation, *Environmental effects, Convective precipitation, Rainfall distribution, Storms, Illinois, *Chicago, St Louis, Missouri.

A study of summer precipitation conditions in the Chicago, Illinois, area sought to discern evidence of urban influences on precipitation processes and on rainfall magnitude by investigating the time and space characteristics of clouds, radar echoes, surface rainfall, and thunderstorms. Historical data for the period 1931 through 1977 anddata from new and special instruments operated during the period 1975 through 1978 were investigated to identify local and regional influences as suggested by precipitation time trends, the areal distribution of heavier rainstorms, thunderstorm frequencies, cloud distributions, radar echo characteristics, raincells, rainfall in discrete rain periods, and total rainfall. An area of 15 percent greater rainfall, which was considered largely a result of urban influences, was identified in central Chicago. Although the degree of change is less than that found in studies at St. Louis, possibly as a result of the inhibiting effects of the lake at Chicago, there was general agreement between these two studies with respect to the placement of the rain change, the synoptic weather conditions when rain changes occur, and the tendency for rain changes to exist in heavier rainfall conditions. Limited causative studies suggest an urban enhancement of convective clouds over Chicago and southern Lake Michigan during the later afternoon. Case studies of radar echo behavior showed that maximum echo intensification repeatedly occurred over the city and at higher elevations than in non-urban cells. (Carroll-FRC)
W82-04741

2C. Snow, Ice, and Frost

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
For primary bibliographic entry see Field 2A.
W82-04303

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
For primary bibliographic entry see Field 2E.
W82-04304

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
For primary bibliographic entry see Field 7B.
W82-04435

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
R. E. Perham.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 442-448, December, 1981. 10 Fig, 1 Tab, 1 Ref.

Descriptors: *Frazil ice, *Ice cover, *Ice formation, Rivers, Water flow, Flow velocity, Line sets, Experimental data.

Laboratory and field tests were performed on frazil ice collector lines to discover methods of promoting solid ice cover formation in fast flowing, shallow river sections. Line sets were composed of nylon parachute cord, nylon twisted rope, nylon braided line, and a combination of nylon, steel, brass, and aluminum, with 1 to 40 lines and different line lengths and spacings. Laboratory tests using a refrigerated flume were conducted with flume depths of 2-22 cm and average flow velocities of 0.08-0.84 m per sec. The tests in small mountain rivers 33-50 cm deep had average flow velocities of 0.6-0.8 m per sec. In the flumes at -23 to -26 C, frazil ice collected rapidly on the test lines, typically reaching a diameter of 3.2 cm in 15 min. Density of the drained ice was 470 kg per cu m, and porosity was 49%. The best river test results were obtained from a set of 20 lines, 3.2 mm diameter, 4.9 m long at a spacing of 38 mm and placed parallel to the streamflow. An ice cover 0.9 m wide and 5 m long formed overnight at about -20 C in swift water, 0.7 m per sec. Ice covers formed either from frazil ice collecting on submerged line sets and then floating to the surface or on lines initially floating. Possible applications for frazil collectors are fringed ice booms, a reinforced ice cover for a power canal or shallow stream, and ice sheet anchors to stabilize large ice sheets. (Cassar-FRC)
W82-04460

CONVECTION PATTERNS IN A POND,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
K. B. Katsaros.
Bulletin of the American Meteorological Society, Vol 62, No 10, p 1446-1453, October, 1981. 5 Fig, 18 Ref.

Descriptors: *Convection, Stratification, *Thermal stratification, *Ponds, *Ice, Ice cover, Snow, Flow pattern, *Slush.

Unusual convection patterns were noted in snow-slush on a pond in Seattle, Washington, during January of 1980 and again during February of 1981. The patterns resemble a spoke-type convection discovered experimentally by Busse and Whitehead in 1974. The first reference to large-cell patterns on a pond was made in Surrey, England, in 1946. Similar findings were reported in 1958 concerning a pond in Darmstadt, Germany, with one or two open spots in the centers. The pond in current question is a shallow and seasonal one, drying up in the summer and filling from rains in the fall. No discernible inflow or outflow exists. Temperatures at the bottom of the pond were 1.5 to 2 degrees C, while the slush layer on top was at zero degrees C and 0.08 meter in thickness. Air temperature above the pond was about 0.5 degrees C. At the time the pictures were taken, the pond was stably stratified. (Baker-FRC)
W82-04461

ACID SNOW IN THE CANADIAN HIGH ARCTIC,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
R. M. Koerner, and D. Fisher.
Nature (London), Vol 295, No 5845, p 137-140, January 14, 1982. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Snow, *Chemical analysis, Precipitation, Snow sampling, Arctic regions, *Air pollution effects, Environmental effects, *Acidity, Canada, *Ice, Arctic, Ellesmere Island.

Acid concentrations in ice from part of a 337 meter surface to bedrock core taken on northern Ellesmore Island are presented. The sample represents the past 5000 years and was compared with the significantly higher acid concentrations occurring in snow deposited over the past 25 years at the same location, showing seasonal variations in the concentrations which together constitute a significant trend of increasing acid levels over the past 25 years. The most highly acid snow is located at the snow surface when melt begins in May or June in the high Arctic. Unless this melt refreezes at the base of the snowpack, the first runoff in spring will be the most acid. Acid levels in high Arctic snow and their effects should be monitored, especially in areas where the lake fish form a source of Inuit income. Concentrations of sodium, calcium, potassium, and magnesium along with insoluble particulates were also maximum in the spring. (Baker-FRC)
W82-04542

SEVERE SNOWMELT RUNOFF IN NORTH-EAST ENGLAND AND ITS IMPLICATIONS,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04648

2D. Evaporation and Transpiration

SPACING AND TRANSPIRATION OF VARIOUS SIZED CLUMPS OF A DESERT GRASS, HILARIA RIGIDA,
California Univ., Los Angeles, Dept. of Biology.
P. S. Nobel.
Journal of Ecology, Vol 69, No 3, p 735-742, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Transpiration, *Plant tissues, Desert grass, Grasses, Carbon dioxide, *Roots, Groundwater, *Desert plants, Soil-water-plant relationships.

Within-species competition between clumps of the grass Hilaria rigida was investigated using conventional plotless techniques and also by root excava-

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tions. Root distribution was determined and leaf water vapor conductance measured. Larger clumps were found further from a random point as well as separated from their nearest neighboring plants by greater distances than smaller clumps. Larger clumps had more ground area available for their roots. The larger space occupied by the larger clumps presumably reflected their preemption of ground water. On the smaller clumps of less than 10 culms, leaves had a three fold higher rate of transpiration per unit leaf area than had leaves on larger clumps, of over 200 culms. However, the larger clumps had nearly three times as much leaf area per unit ground area. Therefore the depth of water transpired daily did not depend on the size of the clump. Since the amount of carbon dioxide fixed per unit ground area also did not change with clump size, the pattern of small and large clumps may be quite persistent over time. (Baker-FRC)
W82-04295

BLANEY-CRIDDLE COEFFICIENTS FOR WESTERN TURF GRASSES,
Wyoming Univ., Laramie.
J. Borrelli, L. O. Pochop, W. R. Kneebone, I. L. Pepper, and R. E. Danielson.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 333-341, December, 1981. 6 Tab, 15 Ref.

Descriptors: *Consumptive use, *Evapotranspiration, *Turf grasses, *Semiarid lands, *Water supply development, Evaporation, Transpiration, Grasses, Semiarid climates, Urban areas, Water requirements, Water supply, Vegetation effects, Mathematical studies.

Very little data exists on calculating the consumptive use of water by turf grass. Some data on turf grass evapotranspiration recorded from lysimeter studies over extended periods at various locations were used to calibrate a Soil Conservation Service (SCS) modification of the Blaney-Criddle technique of calculating evapotranspiration. Results obtained from the revised method should be useful in yielding fairly accurate estimates of city wide water requirements for turfed areas typical of the western United States for use in long range water supply evaluations. Data from these SCS calculations showed that warm season turf grasses should be used in warm regions because they consume considerably less water than other types. In transition areas with summer temperatures over 25 degrees, cool season grasses may undergo heat stress and suffer a decrease in evapotranspiration rates. (Geiger-FRC)
W82-04310

USE OF MODIFIED BLANEY AND CRIDDLE FORMULA FOR ESTIMATING WATER REQUIREMENTS,
Meteorological Office, Poona (India).
K. Subba Rao, and G. Yazdani.
Mausam, Vol 32, No 2, p 195-200, April, 1981. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Evapotranspiration, *Water requirements, Evaporation, *Irrigation requirements, *India, *Rice, *Sugarcane, Blaney and Criddle method, Crop growth stage coefficient.

Experimental values of the crop growth stage coefficient (Kc) were determined for paddy and sugarcane from lysimeter data recorded at four locations in India. Kc gradually increased with advancement of the crop season, reached a peak at about 65% of the growing season, and then declined. This seasonal variation was similar to potential evaporation. Kc values for sugarcane were 0.6-1.1 and for paddy, 0.5-11, 0.6-1.4, and 0.7-0.9 at 3 locations. Ratios of potential evapotranspiration to pan evaporation were 0.9-1.7 for paddy and 0.5-2.0 for sugarcane. The modified Blaney and Criddle method was used to compute evapotranspiration using Kc derived in this work. Differences from measured values for paddy ranged from -6.4 to 16.8 mm. Previous work, which probably used Kc unsuitable for these locations, obtained values differing from the observed values by -40.6 to +29.0. (Cassar-FRC)
W82-04667

MODELLING EVAPORATION FROM RESERVOIRS,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Hydrological Sciences Bulletin, Vol 26, No 4, p 363-367, December, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Reservoirs, *Water temperature, *Numerical analysis, *Reservoir evaporation, Lakes, Water management, Thermal stratification, Evaporation, Seasonal variation, Energy loss, Evaporation rate, Lake evaporation.

The greater thermal capacity of large reservoirs often delays the response of water temperature to changes in insolation and air temperature, offsetting the usual patterns of increased evaporation in the summer. A finite differences numerical model for predicting water temperature in the vertical dimension in freshwater reservoirs is described that is based on the annual variation of evaporation. The model is applicable to both small and large lakes, and the seasonal change in peak evaporation from summer (in small lakes) to winter (in large lakes) is satisfactorily simulated. Some differences in actual and model conditions may be observed, especially in March and August, due to the large spatial averaging inherent in both observations and calculations. In areas where water supplies are short, accurate calculations of evaporation rates may be vital to the planning of water management strategies. (Geiger-FRC)
W82-04722

2E. Streamflow and Runoff

RELATION BETWEEN CURVE NUMBER AND RUNOFF COEFFICIENT,
Maryland Univ., College Park. Coll. of Engineering.
For primary bibliographic entry see Field 2A.
W82-04266

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
S. L. Dingman.
Hydrological Sciences Bulletin, Vol 26, No 4, p 399-413, December, 1981. 8 Fig, 13 Ref.

Descriptors: *Streamflow, *Snowmelt, *Elevation, *Prediction, *Drainage area, *Alpine regions, Overland flow, Air temperature, Evapotranspiration, Altitude, Flood peak, Precipitation, Catchment areas, Runoff, Hydrologic data, Data collections, Orography, Vermont, New Hampshire.

Elevations in Vermont and New Hampshire are generally very high, with many mountain peaks exceeding 1200 m in height. As elevation increases, so does the mean annual and mean monthly precipitation, snow depth, and snow water equivalents, while mean monthly temperatures decreases. Temperature from National Weather Service networks may be used in conjunction with other data to illustrate how potential evapotranspiration fluctuares with elevation. These combined parameters exert strong elevational increases in mean annual streamflow and cause both short term and annual streamflow variability to decrease with the mean elevation of the drainage basin. As mean basin elevation increases above 340 m, low flows for a given exceedance probability show marked increases. For a given return period, flood peaks are also enhanced with increases in mean basin elevation. Although slope and aspect influence the timing of snowmelt runoff, these values exert little effect on hydrology. Usually elevation can be used as the single independent variable for predicting streamflow parameters. (Geiger-FRC)
W82-04304

CONFORMAL MAPPING FOR CHANNEL JUNCTION FLOW,
Malviya Regional Engineering Coll. Jaipur (India), Dept. of Civil Engineering.
P. N. Modi, P. D. Ariel, and M. M. Dandekar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1713-1733, December, 1981. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Channel flow, *Flow characteristics, Streamflow, Hydraulics, Conformal mapping, Mapping, Open-channel flow, Stagnant water, Free-streamline theory, Mapping, *Channel junction flow.

Analysis of flow behavior at channel junctions where two streams combine to form a third is extended to cases with any junction angle and different bed widths. The solution was obtained with the aid of conformal mapping. For small values of the discharge ratio (discharge in channel 2 less than in channel 1) the stagnation point is along the channel 2 boundary closest to channel 1. In the opposite case, greater discharge in channel 1, the stagnation point coincides with the upstream corner at the junction point of the 2 channels. Relationships are developed for the location of the stagnation point with respect to junction angle and the ratio of bed widths of the two channels. For different locations of the stagnation points in the channel junctions, the solutions of the equation for the free-streamline are presented in dimensionless form. The location of the zone of stagnant fluid between the free-streamline and the channel boundary changes with changes in junction angle and as the stagnation point shifts from one channel to the other. (Cassar-FRC)
W82-04306

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04307

FLOOD PROBABILITY ESTIMATION,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W82-04318

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,
Department of the Environment, Vancouver (British Columbia).
For primary bibliographic entry see Field 2K.
W82-04326

DETENTION BASINS--AN URBAN EXPERIENCE,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 4A.
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,
Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
A. V. Metcalfe, and J. A. Mawdsley.
Water Resources Research, Vol 17, No 6, p 1715-1721, December, 1981. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Reservoir design, *Drought, *Low flow, River flow, *Flow augmentation, Poaka Beck reservoir, Crake River, *United Kingdom, Reservoir storage, Pumped storage, Minimum flow, Water transfer.

A model was developed for estimating extreme low flows with a certain probability of nonexceedance for reservoirs where natural inflow from a river is supplemented by pumping from an adjacent river. The method is based on the joint probability distribution of an extreme value distribution and a truncated extreme value distribution. The

estimates of the probabilities of given low flows are made using integrals which are evaluated numerically for a range of low flows and maximum daily pumping rates. Results obtained by applying the derived density function to 25 years of data from the Poaka Beck reservoir and the River Crake in northwest United Kingdom are given for a 3-month drought. This detailed model has several advantages: effects of varying parameters can be studied, flow sequence simulation is not necessary if a suitable distribution for pumped flows can be hypothesized, and the distributional models suggested for the low flows of the two streams are easier to justify than any other particular choice of distribution. (Cassar-FRC)
W82-04334

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W82-04339

RECONSTRUCTED STREAM FLOW FOR THE SALT AND VERDE RIVERS FROM TREE-RING DATA,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
L. P. Smith, and C. W. Stockton.
Water Resources Bulletin, Vol 17, No 6, p 939-947, December, 1981. 6 Fig, 5 Tab, 20 Ref.

Descriptors: Floods, Droughts, *Dating, *Streamflow, *Salt River, *Verde River, *Arizona, Trees, History, Flood peak, Precipitation, Planning, Water supply, Tree rings technique.

Tree ring data were used to extend streamflow records of the Salt and Verde Rivers, Arizona, back to 1580 A.D. The reconstruction of streamflows indicates that the available gaged records dating back to 1889 contain an above average number of high seasonal and annual flows when compared with the 400 year period. Peak flows may be similarly biased, making designs based on historical records of peak flow conservative. The average frequency of occurrence of annual and seasonal discharges associated with the peak flows has remained constant over the 400 year mean. Therefore, water supplies estimated using the historical means may be overestimated. Several long periods of low annual discharge, more severe than in the 1890 to present period, occurred on the average of every 22 years during the reconstructed period. In the Salt River Basin 1905-1920 was the wettest period in the 400 year period. A severe 5 year drought ended in 1670. Another low flow period was 1728-1739, during which average annual discharge was only 43% of the 400 year mean. The Verde River basin had high flows in the early 1900's and low flows at the turn of the century. The most severe drought was in the mid-1770's to mid-1780's. A possible low flow period, based on only 1 tree ring series, was 1580-1620. In general low and high flows in the Verde River coincided with those in the Salt River. (Cassar-FRC)
W82-04340

COMPARISON OF TWO AUTOREGRESSIVE MODELS FOR MONTHLY STREAM FLOW GENERATION,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and M. A. Khan.
Water Resources Bulletin, Vol 17, No 6, p 1035-1041, December, 1981. 8 Tab, 28 Ref.

Descriptors: *Streamflow, *Stochastic hydrology, Model studies, Reservoir storage, Thomas-Fiering model, Spolia-Chandler model, *Comparison studies, Laos, Thailand, Cambodia.

Two closely-related autoregression models for monthly streamflow generation were compared by theoretical consideration and practical applications to flow data from stations in Laos, Thailand, and Cambodia. The Thomas-Fiering model (1962) was superior to the Spolia-Chandler model (1974). The latter model is a reduced parameter modification of the Thomas-Fiering model. Errors in the reproduction of the correlation coefficient and skewness coefficient by the Thomas-Fiering model occurred during months when parameters are nearly zero. This is considered a remediable situation. The gamma random generator produced better results than the lognormal random generator in most cases. (Cassar-FRC)
W82-04351

SEARCH: A GAGED WATERSHED INVENTORY,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 10B.
W82-04433

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,
For primary bibliographic entry see Field 7B.
W82-04482

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04490

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
R. B. Ryder, M. P. Thomas, and L. A. Weiss.
Connecticut Water Resources Bulletin No 24, 1981. 78 p, 41 Fig, 23 Tab, 76 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Hydrologic data, Hydrologic cycle, Aquifers, Aquifer characteristics, Wells, Water supply, Streamflow, Sediment transport, Precipitation, Runoff, Chemical analysis, Maps, *Connecticut, *Upper Connecticut River basin.

The 508 square-mile upper Connecticut River basin during the 1931-60 period received an average of 44 inches of precipitation per year; evapotranspiration averaged 22.2 inches per year while inflow from streams was approximately 4,060 billion gallons per year. Flow out of the basin in the Connecticut River at Portland, Conn., averaged 4,230 billion gallons per year. In 1968, freshwater use was estimated at 108,547 million gallons, a small fraction of the total available. Ground-water sources in the basin yield from several million gallons per day at large well fields to 1 gallon per minute from single wells. Stratified-drift aquifers are the most productive and individual well yields of 100 gallons per minute or more are common. Bedrock aquifers that underlie the basin generally yield a few gallons a minute and are adequate sources for domestic supply. Surface-water samples collected at 25 sites in the area had median dissolved-solids concentrations of 113 milligrams per liter at high flow and 148 milligrams per liter at low flow. Ground-water samples from 164 wells had dissolved-solids concentrations that ranged from 52 to 2,060 milligrams per liter. High concentrations of iron, manganese, sulfate, sodium, and hardness cause ground-water quality problems in parts of the area. (USGS)
W82-04505

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-04506

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-138751, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-8, 1981. 68 p, 36 Fig, 7 Tab, 21 Ref.

Descriptors: *Streamflow, *Water quality, *Precipitation, *Flow characteristics, Low flow, Flow duration, Fluvial sediments, Sediment discharge, *Kansas, Soldier Creek basin, Flood frequency, Comparison studies.

Hydrologic data from Soldier Creek basin, northeastern Kansas, were compared with relations from statewide data. The quantity and quality of streamflow were affected mostly by soils, slopes, and land use. Average annual precipitation during the study (1964-76) was 35.12 inches, or 2.3 percent greater than the long-term (1929-76) average. The average streamflow in Soldier Creek at Topeka was 23 percent greater than the long-term average. In general, frequency curves of annual peak discharges compared poorly with curves from statewide relations due to the absence of extremely low peaks during the short period. A comparison of low-flow frequency for drainage areas of more than 100 square miles suggests that reasonable results may be obtained by extrapolating the statewide relations to small basins. Comparisons of flow-duration curves confirms the extrapolation for basins of less than 100 square miles, although the percentage duration of mean flow is variable. Water surveys showed that calcium, bicarbonate, and sulfate were the predominant ions and dissolved solids were derived mostly from limestones and shales. Suspended sediment at gaged sites ranged from 9.84 to 848 tons per days; yield per unit area increased significantly between two sites due to changes in slopes and land use. (USGS)
W82-04519

DISASTER BY FLOOD,
National Oceanic and Atmospheric Administration, Boulder. Environmental Research Labs.
L. R. Hoxit, H. S. Lieb, C. F. Chappell, and H. M. Mogil.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981. p 23-45, 15 Fig, 27 Ref.

Descriptors: *Thunderstorms, *Flash floods, Precipitation, Flood forecasting, *Flood damage, Disasters, Flooding, Rainfall distribution, Warning systems, Canyons, *United States.

During the 1970's flash floods were the leading cause of death and destruction from weather-related causes; they have devastated parts of nearly every state. More than 15,000 communities and recreational areas have been identified as vulnerable to flash floods. Increased use of mountainous areas for recreation and canyons for home building has greatly increased the potential for disaster. The Big Thompson Canyon flash flood of 1976 is an example of the meteorological processes, the problems of warning and preparedness, and the human response to floods. Intense thunderstorms produced up to 12 inches of localized rainfall within a few hours over the rugged Big Thompson River drainage in north-central Colorado. The normally placid river received great quantities of water from several tributaries. Near Drake, the flow on the river just before the rain began was 137 cfs; the peak flow was 31,200 cfs. Only a few hours separated the onset of heavy rain from the flood crest passing the canyon mouth. The phenomenal local episode was appreciated only after it was under way, and many people either disregarded warnings or received no warning. The flash flood that swept through the canyon and onto the plains resulted in 139 casualties and property damage estimated at $35 million. The toll taken by flash floods in the future will be determined by the nature and density of settlements, the quality of flood control measures, the systems used for acquiring and interpreting meteorological observations, forecast and

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warning communications, and responses to warnings. (Moore-SRC)
W82-04618

THE DISASTROUS SOUTHERN CALIFORNIA AND CENTRAL ARIZONA FLOODS, FLASH FLOODS, AND MUDSLIDES OF FEBRUARY 1980.
National Weather Service, Silver Spring, MD.
Natural Disaster Survey Report NWS-81-1, March, 1981. 128 p, 28 Fig, 3 Tab, 7 Append.

Descriptors: *Floods, *Flash floods, Flood forecasting, *Mudflows, Rainfall distribution, Weather forecasting, Warning systems, *Flood damage, *California, *Arizona.

For 9 days during mid-February 1980, the southwestern U.S. was battered by a series of heavy rainstorms. Over the period, 5 inches or more of rain fell over most of Southern California's coastal valleys, and some mountain areas received over 25 inches. Rainfall amounts in Central Arizona ranged from 1 to over 16 inches. The large rainfall amounts produced floods and flash floods in many areas, and mudslides were a major problem in Southern California. Overall, the NOAA warning systems worked well in both California and Arizona. The Los Angeles Weather Service Forecast Office (WSFO) issued watches, warnings, and statements well in advance of flooding, flash flooding, and mudslides. The Phoenix WSFO also issued timely flood/flash flood watches, warnings and statements. All indications are that the NOAA services contributed significantly to reducing property losses and probably deaths. Nevertheless, 21 people died as a direct result of flooding, flash flooding, and mudslides; and total property damage in the two states topped $400 million. Part of these losses might have been prevented if, in some cases, more effective action had been taken on the part of the public. One factor that apparently contributed to citizen inaction during this disaster was the inability to give a more precise description of the rainfall distribution in the warning statements. (Moore-SRC)
W82-04632

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,
Lancaster Univ., Bailrigg (England).
For primary bibliographic entry see Field 7B.
W82-04643

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1023-1035, December, 1981. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Flood forecasting, Risks, *Seasonal variation, *Flood frequency, *England, Rainfall-runoff relationships, Soil water, Storm water, Streamflow forecasting.

A method for seasonal flood analysis is presented. It is based on the percentage of the annual number of floods above a given return period occurring in each month. Variations in seasonal regime are identified for stations in northeast England. These are related to controlling factors of storm rainfall and catchment wetness. A graph depicts the relationship between construction period/design life, return period, and the risk of flood occurrence. A table gives the percentage of annual number of flood events above a given return period occurring each month in three regions. This method can determine the seasonal flood risks to crops grown on a flood plain or to construction projects such as bridges, outfalls, and piers. (Cassar-FRC)
W82-04646

SEVERE SNOWMELT RUNOFF IN NORTHEAST ENGLAND AND ITS IMPLICATIONS,
Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1049-1060, December, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Flood forecasting, *Snowmelt, *Runoff rates, Forecasting, Snow density, Snow depth, Melting, Streamflow forecasting, *England.

Measured snowmelt runoff rates in northeast Britain were considerably higher than those obtained from meteorological data. Analysis of snowmelt rates in 1978-97 confirmed earlier observations of runoff rates. The differences in rates were attributed to limitations in data on which the meteorological conclusions were based. No deep snowpacks were included in the estimates of water equivalent depletion. Rates of depth depletion do not directly indicate melt or yield. Densities of snowpacks in the uplands were also much higher than in the lowlands because of higher windspeeds, greater compaction due to deeper snow, and lower temperatures. These discrepancies can cause underestimates of probable maximum floods. (Cassar-FRC)
W82-04648

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,
Karlsruhe Univ. (Germany, F.R.).
G. Troubounis, H. H. Hahn, and B. Eppler.
Water Science and Technology, Vol 13, No 11/12, p 677-682, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality, *Monitoring, Water pollution control, Hydrologic data, Rivers, Data collections, Data acquisition, Detection times, Detention time, Streamflow.

The corresponding residence or travelling time between monitored river cross sections is a necessary piece of information in conceiving a river quality monitoring program. This traveling or transit time is a function of the discharge rate of the river itself. The problems encountered in residence/traveling time determinations are discussed. Two methods are described which are more compatible with water quality considerations than the well known hydraulic computations: the use of iso-concentration graphs based on data for concentration changes of conservative water constituents, and time series analysis methods. Comparing the computed flow and traveling times between predetermined cross-sections, one finds significant differences between hydraulically computed data and those determined on the basis of water quality measurements. It is concluded that if automatic sampling or quasi- continuous analyses exist, then such data will form a sufficient basis for the determination of residence and traveling times in free flowing as well as impounded rivers. If periodic variations or oscillations in the quality of a river exist, then such quasi-continuous or continuous measurements on concentration changes of conservative substances can be used for a detention time determination on the basis of iso-concentration diagrams. If no periodic fluctuation in the concentration of conservative water constituents can be observed, but non-conservative substances are available, then the method using the cross-correlation function should be employed. (Baker-FRC)
W82-04663

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,
Flood Meteorological Office (India).
For primary bibliographic entry see Field 2B.
W82-04670

THE FUTURE OF FLOOD ESTIMATION AND THE FLOOD STUDIES REPORT,
Northumbrian Water Authority, Gosforth (England).
P. Johnson.
Proceedings of the Institution of Civil Engineers. Part I. Design and Construction, Vol 70, No 3, p 833-843, 1981. 1 Tab.

Descriptors: *Flood flow, *Flood plain management, *Spillway capacity, *Rainfall, *Snowmelt, Floof forecasting, Flood-control storage, Floods, Data collections, Urban areas, Catchment areas, Runoff, Reservoirs, *United Kingdom.

The proceedings of the 1975 conference, The Flood Studies Report (FSR) held by the Hydraulics and Public Health Engineering Board of the Institution of Civil Engineers, are summarized in the committee chairman's report. Priority tasks to improve upon and extend the FSR are mainly ones of better mapping of flood boundaries, finding the adequacy of urban catchment, and estimating more accurately the trends and cycles of floods. Several priority tasks for updating the FSR will require more sophisticated and broader data base analyses. The REGIME concept for relating discharge to river channel cross-sectional areas and other features should be studied for application to the FSR. The URBAN program was adopted to aid in estimating flood discharges in or as a result of urban areas. Radar is suggested for more accurate data collections on rainfall. Information on snowmelt also needs more development. Plans were made to survey all major spillways in the British Isles and to examine wind velocities and directions of storms causing flood inflow. Recommendations to expand data on reservoirs in an engineering guide were also made. Extrapolation of FSR methods for use overseas and training in the proper understanding of the report are considered. (Geiger-FRC)
W82-04687

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,
Institute of Hydrology, Wallingford (England).
J. C. Bathurst, R. M. Li, and D. B. Simons.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1593-1613, December, 1981. 11 Fig, 8 Tab, 21 Ref.

Descriptors: *Channel flow, *Flow resistance, *Hydraulic roughness, Flumes, Reynolds number, Rocks, Roughness coefficient, Froude number, Channel morphology, Resistance, *River beds, Bed material, Particle size, Mountain streams.

Flow in channels with large-scale roughness, such as boulder-bed channels increasingly being used in developing mountainous areas, was investigated in a steep stream flume. Bed material was of five different sizes, from 0.5 to 2.5 inches. A flow resistance equation was developed for this situation, in which the ratio of flow depth to mean element height was less than 4. The flow resistance in large-scale roughness depended on the form drag of the elements and their deposition in the channel. The relevant processes of flow were described as functions of Reynolds number, Froude number, roughness geometry, and channel geometry. Values predicted by this equation and by other workers for the Upper River Tees, United Kingdom, were compared with observed values. Agreement was generally good, but further refinement is necessary to account for variations in channel width and element shape. (Cassar-FRC)
W82-04696

2F. Groundwater

A GROUND WATER RESOURCES STUDY OF A PACIFIC OCEAN ATOLL--TARAWA, GILBERT ISLANDS,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, J. C. Miles, G. R. Chessman, and S. F. Bugg.
Water Resources Bulletin, Vol 16, No 4, p 646-653, August, 1980. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater potential, *Resistivity, *Atolls, Groundwater availability, Groundwater management, *Tarawa, *Gilbert Islands, Water supply, Drought, Aquifers, Lenses, Islands.

Groundwater resources were investigated in Tarawa, Gilbert Islands, typical of thousands of small atolls in the Pacific Ocean. Surface resistivity

measurements were combined with an electrical conductivity survey of well waters to establish the size and shape of fresh water lenses. Most wells in this atoll intercept only the top edge of the lens. Although precipitation is the controlling factor for groundwater recharge input, there is a 15% interception loss. Steady state conditions were not appropriate for modeling water resources in this atoll because long periods occur during which there is no recharge. Therefore nonsteady digital modeling methods were used to analyze the groundwater resources in the largest 4 of the 8 atolls in the Tara group. Results of the study showed that the 4 main lenses can supply water adequately for a 2% drought of 2-year duration. To prevent saline water intrusion, water should not be abstracted during the second year of a drought. Once a lens has been overabstracted, it may not recover. Increasing populations in these islands, the susceptibility of lens resources to drought, and the expense and difficulty of obtaining alternate intermittent water supplies are problems common to many Pacific atolls. (Cassar-FRC)
W82-04254

DELAYED DRAINAGE IN A STREAM-AQUIFER SYSTEM,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 407-410, December, 1981. 1 Fig, 7 Ref.

Descriptors: *Groundwater movement, *Subsurface drainage, *Mathematical models, *Drainage wells, *Unconfined aquifers, Aquifers, Drainage, Model studies, Hydrologic models, Mathematical studies, Water table, Mathematical equations, Flow patterns, Fully penetrating wells, Streams.

An explanation of Higgins' results for nonsteady flow from an unconfined aquifer into a fully penetrating stream in which the water level fluctuates in a prescribed pattern was developed which does not account for unsaturated flow. The proposed theory is similar to that of Higgins, except that the aquifer material is assumed to be uniformly elastic and the water compressible, and the aquifer itself is assumed to be anisotropic. The new theory is based on the concept of delayed drainage as applied to the problem of unconfined flow to a well. At small values of time, the water table drawdowns observed experimentally by Higgins exceeded those predicted by his theory, while at large values of time, some of the water table drawdowns observed by Higgins were less than those predicted by his theory. A simple explanation of how this situation occurs and equations to remedy this problem are presented. (Geiger-FRC)
W82-04268

THE SEEPAGE FLOW THROUGH A FREE BOUNDARY AQUIFER INTO A RIVER,
Reading Univ. (England). Dept. of Mathematics.
J. O'Shea, and M. J. Baines.
Hydrological Sciences Bulletin, Vol 26, No 4, p 415-411, December, 1981. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Groundwater movement, *Mathematical models, *Numerical analysis, Model studies, Hydrologic models, Aquifers, Mathematical studies, Mathematical equations, Rivers, *Influent streams.

A model of groundwater flow from an aquifer beneath a river into the river channel is presented in order to determine the discharge q into the river for different values of the boundary data, namely at the river boundary and at the outer edge of the aquifer. Information from this model may be applied for calculating the total water conten in a river or the inflow conditions when modeling water systems. The solution procedure for solving Laplace's equation utilizes a variational inequality, which yields a numerical approximation solution using finite differences. The discharge parameter q is determined from Neumann boundary conditions and iterations on q using a compatibility condition obtained by the discretizing of discharge equations. (Geiger-FRC)
W82-04305

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 4B.
W82-04309

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,
International Engineering Co., Incorp., San Francisco, CA.
M. V. Damm.
Water Resources Bulletin, Vol 16, No 5, p 907-913, October, 1980. 11 Fig, 2 Tab, 8 Ref.

Descriptors: *Groundwater, *Pumpage, Aquifers, Recharge, River basins, Simulation, *Groundwater recharge, Model studies, *Hydrologic budget, Nebraska.

The purpose of this paper is to explore the hydrologic effects of implementing an allocation scheme in an area where groundwater pumpage provides a substantial portion of the applied water. In general a reduction of pumped groundwater applied at the surface will result in less recharge to the groundwater body. Recharge will decrease in an amount approximately equal to the decrease in pumpage, as long as the water pumped is in excess of actual water needs. Simulation of a stream-aquifer system in Nebraska was undertaken to determine estimates of the effects of controls on groundwater withdrawals. Due to uncertainties in the calibration processes and projections of various types of data and to simplifications employed in the models, the results of the simulation most likely include some error. The relatively small savings from reductions in pumpage result primarily from recirculation effects. Differences between groundwater contributions to stream flow were small for all simulations examined. These contributions decreased with time and increased pumpage amounts. base flow rates at the end of the simulation were about 25% of those at the beginning. (Baker-FRC)
W82-04428

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,
Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
For primary bibliographic entry see Field 7B.
W82-04436

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,
Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04451

A NUMERICAL LINKED MODEL FOR THE PREDICTION OF THE DECLINE OF GROUNDWATER MOUNDS DEVELOPED UNDER RECHARGE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. A. Kashkuli.
PhD Thesis, July, 1981. 159 p, 21 Fig, 7 Tab, 59 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-26436.

Descriptors: *Model studies, *Mathematical models, *Groundwater recharge, Groundwater movement, Saturated flow, Water table, *Groundwater mounds.

A model is developed to couple the approximate solution of one-dimensional vertical partially saturated flow to the two-dimensional saturated horizontal flow. The linked model is used to predict the decline of a groundwater mound developed under recharge areas. It consists of linking beneath the recharge area one-dimensional vertical unsaturated columns to a two-dimensional areal saturated flow model. Besides the Dupuit-Forchheimer assumptions in the saturated flow, it is further assumed that the partially saturated flow is vertical. The solution of the equation governing the partially saturated flow above the water table determined the recharge and storage information needed for the solution of the saturated flow equation. The model simulates the lateral unsaturated flow by an equivalent permeable height and uses an equivalent saturated height to account for a changing specific yield. The model was verified by comparing the results for a certain problem to those predicted by a rigorous model. A field size problem of strip recharge was simulated and solved. It was found that for this particular problem the water table decline rate is considerably faster if the traditional approach of excluding the unsaturated flow region is employed. In this model both Su-Brooks and Brooks-Corey methods for determining soil parameters can be used. (Sinha-OEIS)
W82-04481

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 6D.
W82-04486

DIGITAL MODELS OF GROUND-WATER FLOW IN THE CAPE COD AQUIFER SYSTEM, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
J. H. Guswa, and D. R. LeBlanc.
Geological Survey Open-File Report 80-67 (WRI), 1981. 128 p, 60 Fig, 12 Tab, 19 Ref.

Descriptors: *Groundwater, *Computer models, *Coastal aquifers, *Unconfined aquifers, Groundwater movement, Saline-freshwater interfaces, Regional development, Prediction, Hydrologic data, Finite difference methods, *Massachusetts, *Cape Cod.

The Cape Cod aquifer system was simulated with three-dimensional finite-difference ground-water-flow models. Five areas were modeled to provide tools which can be used to help predict the hydrologic impacts of regional water development and disposal schemes. Model boundaries were selected to represent the natural hydrologic boundaries of the aquifer. The boundary between fresh and saline ground water is treated as an interface of no dispersion, and the saline-water zone is treated as being non-flowing. Comparisons of calculated and observed head values, position of the freshwater and saline-water boundary, and ground-water-discharge rates at locations where data are available indicate that the simulated ground-water reservoirs generally agree with the field conditions and the models can be used for predictive studies. (USGS)
W82-04487

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04489

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
J. M. Kernodle.

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Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142852, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-70, 1981. 53 p, 28 Fig, 26 Ref.

Descriptors: *Computer models, *Groundwater, *Aquifer systems, *Water management, Geohydrology, *Groundwater movement, Observation wells, Water level, Hydraulic conductivity, Available water, *Mississippi, *Lee County, Eutaw-McShan aquifer, Gordo aquifer.

A two-dimensional ground-water flow model of the Eutaw-McShan and Gordo aquifers in the area of Lee County, Miss., was successfully calibrated and verified using data from six long-term observation wells and two intensive studies of areal water levels. The water levels computed by the model were found to be most sensitive to changes in simulated aquifer hydraulic conductivity and to changes in head in the overlying Coffee Sand aquifer. The two-dimensional model performed reasonably well in simulating the aquifer system except possibly in southern Lee County and southward where a clay bed at the top of the Gordo Formation partially isolated the Gordo from the overlying Eutaw-McShan aquifer. The verified model was used to determine theoretical aquifer response to increased ground-water withdrawal to the year 2000. Two estimated rates of increase and five possible well field locations were examined. (USGS)
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04498

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04505

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04507

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04512

CARBONATE GEOCHEMISTRY OF VADOSE WATER RECHARGING LIMESTONE AQUIFERS,
Kentucky Univ., Lexington. Dept. of Geology.
J. Thrailkill, and T. L. Robl.
Journal of Hydrology, Vol 54, No 1-3, p 195-208, December, 1981. 4 Fig, 3 Tab, 20 Ref. OWRT-A-009-KY.

Descriptors: *Geochemistry, *Vadose water, *Groundwater recharge, Carbonates, Aquifers, Flow, Seepage, Caves, *Limestone aquifers.

An investigation of the carbonate equilibrium of water which is transiting the vadose zone in Kentucky caves included repeated sampling at the same sites to examine possible seasonal variations. Also, measurements were made of discharge at the sources, and the pH was determined as soon as possible after the water entered the cave environment. Furthermore, the carbonate chemistry of the soil waters overlying at least some of the sites was investigated. An apparent chemical distinction could be made between vadose flows and vadose seepage, with the vadose flows being originally more undersaturated with respect to calcite. Calcite is actively dissolved as water passes through the vadose zone. Two types of vadose seepage were identified: low-Ca vadose seepage and high-Ca vadose seepage. High-Ca vadose seepage is probably the most abundant source of recharge to limestone aquifers which are not overlain by other lithologies. (Small-FRC)
W82-04526

THEORY FOR AQUIFER TEST ANALYSIS IN FRACTURED ROCK UNDER LINEAR (NONRADIAL) FLOW CONDITIONS,
Water Futures, Albuquerque, NM.
D. N. Jenkins, and J. K. Prentice.
Ground Water, Vol 20, No 1, p 12-21, 1982. 11 Fig, 13 Ref.

Descriptors: *Mathematical studies, *Aquifers, *Groundwater movement, *Pump wells, Mathematical equations, *Geologic fractures, Drawdown, Permeability, Fracture permeability, Flow pattern, Graphical methods.

If a well penetrates a geologic fracture with a permeability much greater than that of the surrounding aquifer, then the flow of groundwater in a fractured rock aquifer may be linear toward a natural production surface rather than radial toward a pumping well. Such linear flow has been discovered in fractured rock aquifers in three distinct areas of New Mexico. Similar aquifers were identified from aquifer test data in Mendocino and Placer Counties in California. Conventional methods of aquifer analysis were deemed inadequate due to curvilinear test data on semi-log plots and straight line data on log-log plots. Mathematical methods of fitting straight lines to arithmetic plots of pumped well and observation well data showed that the flow in the vicinity of the test well was linear. Flow lines in a linear system are parallel, and drawdown is a function of the perpendicular distance from the extended well. (Geiger-FRC)
W82-04676

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,
Systems, Science and Software, LaJolla, CA.
For primary bibliographic entry see Field 6A.
W82-04732

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,
Arizona State Univ., Tempe. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-04742

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1A.
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,
Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
For primary bibliographic entry see Field 1A.
W82-04744

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,
Moody and Associates Inc., Meadville, PA.
For primary bibliographic entry see Field 5B.
W82-04750

2G. Water In Soils

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 7B.
W82-04325

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W82-04333

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker, N. Van Vliet, and H. W. Molenaar.
Water SA, Vol 7, No 4, p 255-264, October, 1981. 6 Fig, 7 Tab, 13 Ref.

Descriptors: *Water table rise, *Irrigation effects, *Saline soils, Crop yield, Drainage, Conductivity, Water pollution effects, Soil water, *Vaalharts Irrigation Project, *South Africa, Soil compaction, Soil density, *Saline water intrusion.

Overirrigation and leakage from soil dams produced a shallow groundwater table of 0.9-1.5 m at the Vaalharts Irrigation Scheme, South Africa. The water table rose further to 0.3-0.6 m from the surface during above average rainfall on occasions during 1974-1976, allowing salt accumulation and reducing yields of wheat, cotton, maize, and groundnuts to nearly zero. There was a correlation between electrical conductivity of the topsoil and wheat yield. Factors having a detrimental influence on seed germination and seedling growth were sodium absorption ratio less than 4, high bulk density, and high soil moisture content. The soil characteristics were a result of mechanical cultivation of the fine sandy soil and the shallow ground water table. Irrigation practices should be improved and drains installed if necessary. (Cassar-FRC)
W82-04359

EFFECT OF SURFACE SEALING ON INFILTRATION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore.
Transactions of the ASAE, Vol 24, No 6, p 1546-1552, 1561, November/December, 1981. 6 Fig, 8 Tab, 40 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Surface permeability, Soil types, *Model

studies, Richards equation, Ponding, *Soil properties.

Numerical solutions of Richards' equation showed the effects of surface sealing of soils on infiltration. The three conditions examined in the model were: (1) no seal, (2) developing seal, gradual surface sealing under rainfall activity, and (3) constant seal, a well-established surface seal. Rainfall application rate was 5.3 cm per hour. Measurements on nine A-horizon soils from different counties in Minnesota and Wisconsin were used as model inputs. Results indicated that surface sealing, virtually ignored in infiltration modeling in the past, reduced predicted infiltration rates and volumes by up to 80%. This may account for some of the differences in infiltration behavior observed by different researchers using the same soil type. (Cassar-FRC)
W82-04362

DEEP TILLAGE OF IRRIGATED PULLMAN CLAY LOAM--A LONG-TERM EVALUATION,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
J. T. Musick, D. A. Dusek, and A. D. Schneider.
Transactions of the ASAE, Vol 24, No 6, p 1515-1519, November/December, 1981. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Irrigation efficiency, *Cultivation, *Infiltration, Drainage, Furrow irrigation, Corn, Wheat, *Crop yield, Sorghum, Grain crops, Soil compaction, Soil density, Agriculture, Water stress, Bushland, Texas, Soil-water-plant relationships.

One-time deep moldboard plowing in 1966 to depths of 0.4, 0.6, and 0.8 meters in slowly permeable Pullman clay loam at Bushland, Texas, increased water intake and crop yield (wheat, sorghum, and corn) during subsequent years. This study reports the results of evaluations in the 1973-79 interval. Soil was disturbed by the deep plowing, which mixed some of the topsoil with lower layers so that the soil had a crumb-type structure, compared with the previous blocky peds. Compared with 0.2 m conventional tillage, the one-time deep tillage increased irrigation water uptake from 120 to 240 mm in 1975 and from 170 to 280 mm in 1978. This effect did not diminish with time. As soil compacted during the growing season from wheel traffic and irrigation water, the water permeability decreased. This was restored by conventional moldboard plowing to 0.2 m. The deep tillage treatment increased sorghum grain yields (in kg per ha) from 6040 to 7290 in 1975 and 9080 to 9960 in 1979. Similarly, corn yields (in kg per ha) were increased from 10,020 to 11,300 in 1977. The increased water intake and the deeper profile wetting of the deeply plowed fields delayed the beginning and reduced the severity of plant water stress. The deep-tillage method is most effective in the normally drier, lower parts of graded furrow irrigated fields, where tailwater runoff can be reduced. It is not recommended for upper sections of the field, where drainage losses may result. (Cassar-FRC)
W82-04372

INFILTRATION INTO TWO-LAYERED SOIL PROFILES,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore, and J. D. Eigel.
Transactions of the ASAE, Vol 24, No 6, p 1496-1503, November/December, 1981. 7 Fig, 5 Tab, 34 Ref.

Descriptors: *Infiltration, *Soil profiles, *Ponding, *Soil water, Model studies, Soil porosity, Green-Ampt Mein-Larson model, Richards equation, Numerical analysis, Loam, Stratification.

Results from the Modified Green-Ampt, Mein-Larson infiltration equations (GAML) for two-layered soil profiles were compared with observed data and results from the numerical solution of Richards' equation. Examples of two-layered soil profiles are plowed soil over undisturbed soil and topsoil over mine spoil. The two-layers of soil used were a Lewiston fine sandy loam (coarse) and a Millville silt loam (fine). Both coarse-over-fine and fine-over-coarse were examined. In the two-layered soil profiles the GAML and numerical models produced similar results (time to surface ponding, infiltration volume, and infiltration rate). Layering sequence was a significant factor in infiltration behavior. Infiltration rates and volumes were lower for fine-over-coarse than for coarse-over-fine stratifications. For the coarse-over-fine profiles there was a general increase in time to ponding as the application rate decreased and surface layer thickness increased. For the fine-over-coarse, layering times to surface ponding predicted by the Modified GAML model were independent of the thickness of the surface layer. However, the time to ponding increased with increasing thickness for the numerical model. Agreement between predicted and observed data ranged from excellent to fair. Best agreement was for the smaller surface layer thicknesses. Both models underpredicted infiltration rates for coarse-over-fine stratifications. (Cassar-FRC)
W82-04536

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,
Punjab Agricultural Univ., Ludhiana (India).
B. K. Sinha, S. R. Singh, and R. G. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 460-461, June, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation practices, *Puddling, Percolation, Crop yield, *Rice, Irrigation requirements, Water loss, *Soil water.

The effect of puddling intensity on the nature of water flow and irrigation requirements of rice crop were investigated in laboratory and field studies. The response to puddling in different soils varied according to the soil texture. The resistance to water flow, as evidence by specific discharge, was increased in all the soils following puddling. The reduction in specific discharge after the first puddling ranged from 6 to 10 fold at different hydraulic gradients in sand. In sandy loam it was small, especially at lower gradients. In silty clay loam soil the reduction was marginal. Apparently puddling could reduce percolation losses only in coarse-textured soils. The second puddling was less effective than the first in reducing the specific discharge, except in sandy loam soil, where the second puddling might have resulted in a more uniform sealing of pores. Thus structure destruction due to puddling may not be of much importance in reducing water flux through the soil. Puddling altered the nature of water flow, particularly in silty clay loam. Increased puddling intensity in fine textured soils did not effect any significant saving in irrigation water. Evidently fine textured soils need not be puddled if the sole aim is to reduce percolation losses. (Baker-FRC)
W82-04671

WATER MOVEMENT IN UNIFORM SOILS DURING CONSTANT-FLUX INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra City (Australia). Div. of Environmental Mechanics.
K. M. Perroux, D. E. Smiles, and I. White.
Soil Science Society of America Journal, Vol 45, No 2, p 237-240, March/April, 1981. 5 Fig, 11 Ref.

Descriptors: *Infiltration, *Soil water, Mathematical models, Mathematical equations, Fluctuations, Absorption, Gravity studies, Ponding, *Soil water movement.

Several studies have addressed the problem of predicting water movement and distribution in soils during nonponding rainfall or sprinkler irrigation. While a variety of numerical methods have been successfully applied to flux boundary conditions for a variety of initial conditions, the search for general analytical solutions to the flow equation for the constant-flux boundary condition initially met with less success. This paper presents an analysis for constant-flux infiltration of water in soil based on the flux-concentration relation. The results of laboratory experiments on constant-flux infiltration into columns of fine sand and silty loam are compared with behavior predicted both with and without a gravitational component. The effect of gravity was shown to be small for the early stage. During the early stage it is possible to make sufficiently accurate predictions of moisture profile development using the simpler absorption analysis of White, et al. (1979). (Carroll-FRC)
W82-04691

2H. Lakes

ESTIMATION OF PRIMARY PRODUCTIVITY IN AQUATIC SYSTEMS USING FREE OXYGEN MEASUREMENTS,
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
R. Lingeman, and S. Vermij.
Water Resources Bulletin, Vol 16, No 4, p 745-748, August, 1980. 2 Fig, 13 Ref.

Descriptors: *Primary productivity, *Oxygen, *Temperature, Lakes, Productivity, Water temperature, *Model studies, Stratification, Heat transfer, Eddy diffusion, Barlosche Kolk, Netherlands.

One-dimensional models for heat or oxygen transport in aquatic systems have been used by several authors to estimate primary productivity. These methods use free oxygen and temperature measurements at discrete time and depth intervals and assume that the eddy diffusion coefficients of heat and oxygen are interchangeable. This method was applied to data from the Barlosche Kolk, a 3.5 ha lake with maximum depth of 6 m. Steep oxygen gradients and moderate temperature stratification are present in summer, but there is no distinct hypolimnion. Temperature and oxygen were measured hourly at 0.5 m intervals of depth. Primary productivity calculated from these data and the model did not agree with simultaneous measurements of primary productivity by the light and dark bottle method. It was concluded that the one-dimensional model is inadequate for this application because the discrete measurements of temperature and oxygen do not provide sufficient data. A more adequate model should include horizontal transports induced by internal waves along the sheets of steep temperature gradients. Continuous recording of temperature and oxygen may provide necessary data. (Cassar-FRC)
W82-04256

WATER BUDGET COMPUTATIONS FOR A SHALLOW--LAKE OKEECHOBEE, FLORIDA,
Florida Univ., Belle Glade. Agricultural Research and Education Center.
S. F. Shih.
Water Resources Bulletin, Vol 16, No 4, p 724-728, August, 1980. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrologic budget, *Storage capacity, *Evapotranspiration, Lakes, *Lake Okeechobee, *Florida, Shallow lakes, Marsh plants, Model studies, Evaporation.

The water budget for Lake Okeechobee, Florida, was computed using a model which included marsh plant evapotranspiration. This model was labeled WET and the conventional methods, without the evapotranspiration factor, WOET. Three periods were used to compare the differences in the sum of storage deviation between the two methods. These periods differed in length: testing (1969-74), planning (1963-74), and recorded period (1952-77). The WOET method gave the following sums of stage deviations: 87.42 cm, 231.80 cm, and 284.5 cm for the three periods respectively. These were equivalent to 29, 76, and 93% of the lake volume. The WOET method overestimated storage, as compared with recorded data, for 21 out of 26 years. The WET method reduced the sum of storage deviation by 42, 31, and 49%, respectively, for the three periods. The sums of stage deviations were 50.72 cm, 160. 08 cm, and 144.81 cm, respectively. Storage deviations were overestimated in 15 out of 26 years. (Cassar-FRC)
W82-04258

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,

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McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters.
Limnology and Oceanography, Vol 26, No 6, p 1150-1161, 1981. 4 Fig, 3 Tab, 40 Ref.

Descriptors: *Lakes, *Phosphorous, Nutrients, Biomass, *Lake Memphremagog, Canada, Rivers, Limnology, Water analysis.

Water samples were taken from Lake Memphremagog and five of its tributaries. The percentage of total phosphorus in the samples which was biologically available was measured on three dates. The criteria used to measure the percentage of biologically available phosphorus were the distribution of radioactive phosphorus among exchanging fractions and the enzymatic release of soluble phosphorus from particulate phosphorus when stored with chloroform. The available phosphorous in the lake water formed 83% of the total phosphorus. The available phosphorous in rivers was only 18-57% of the total, much less than in the lakes. The most refractory fraction was usually high molecular weight phosphorus, and was separated by gel filtration. Substantial amounts of unavailable phosphorus were also associated with particles and with low molecular weights. Intermediate molecular weight soluble phosphorus was too small a fraction for determining its availability. Variations in the percentage of available phosphorus in natural waters could substantially change the biological effect of a given phosphorus load. (Baker-FRC)
W82-04324

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and C. Rubitschun.
Journal of Great Lakes Research, Vol 7, No 3, p 290-298, 1981. 2 Fig, 3 Tab, 32 Ref.

Descriptors: *Phosphorus, *Lake Michigan, Lakes, Phosphates, Bioassay, Chemical analysis, *Fate of pollutants, Pollutant identification, Lake sediments, Phytoplankton.

Soluble reactive phosphorus in the epilimnion of southeast Lake Michigan, measured at a station 15 km from shore in May-October 1976, was higher and more variable than previously published measurements. The overall means were 4.9 micrograms P per liter (range 2.0-10.3 micrograms P per liter) using Harvey's method and 3.4 micrograms P per iter (range 1.2-7.7 micrograms P per liter) using the Chamberlain-Shapiro extraction technique. At times there were significant vertical variations in the water column and near the sediment, but the hypolimnion did not accumulate P. Both methods overestimated maximum possible phosphate-P concentrations up to two orders of magnitude. Maximum possible phosphate-P concentrations as measured by Rigler's radiobioassay method were an average of 22.5% of those measured by Harvey's method and 25.6% of those measured by the extraction technique. Several factors which could cause too-high P measurements were investigated. It was concluded that the values were, in fact, higher because high concentrations of particulates were carried out to distances 10-15 km from shore in this region during the extremely wet year 1976. Data suggest that true phosphate concentrations may be lower in the epilimnion of eutrophic lakes than in mesotrophic lakes because of high biological utilization rates and less efficient recycling mechanisms. (Cassar-FRC)
W82-04377

TEMPERATURES AND CURRENTS IN A STRATIFIED LAKE: A TWO-DIMENSIONAL ANALYSIS,
Arizona Univ., Tucson.
J. Henrich, W. Lick, and J. Paul.
Journal of Great Lakes Research, Vol 7, No 3, p 264-275, 1981. 13 Fig, 36 Ref.

Descriptors: *Water temperature, *Water currents, *Stratification, Lakes, Water circulation, Lake circulation, Temperature, Currents, Wind-driven currents, Thermal stratification, *Lake Erie, *Model studies, Thermocline, Turbulent flow, Heat transfer.

A two-dimensional (vertical and horizontal) time-dependent model was used to predict temperatures and currents in a stratified lake comparable to the central basin of Lake Erie. Stratified flow during the time of formation, maintenance, and decay of the thermocline were investigated. Increasing heat flux to the water causes earlier, shallower, and stronger formation of a thermocline. Increasing turbulence causes later, deeper, and weaker thermocline formation. Heat transfer to the sediment in a shallow lake can decrease hypolimnion temperatures by 1 C. Effects of a sinusoidal 24-hour period heat flux and the temperature distribution of thermal radiation are limited to the near surface region and do not change thermocline formation. Wind stress perpendicular to the cross-section results in a stronger, narrower return flow just above the thermocline than does wind parallel to the cross-section. Wind reversal shifts the orientation of the thermocline so that the hypolimnion waters are shifted in the upwind direction and the thermocline becomes deeper in the downwind direction. If wind has not reversed by 50 days, a second thermocline can form above the first thermocline. In general, calculated results agreed with observations. (Cassar-FRC)
W82-04378

WINTER TEMPERATURE STRUCTURE IN LAKE HURON,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. S. Miller, and J. H. Saylor.
Journal of Great Lakes Research, Vol 7, No 3, p 201-206, 1981. 8 Fig, 1 Tab, 13 Ref.

Descriptors: *Water temperature, Stratification, *Mixing, Lakes, *Lake Huron, Temperature, Water depth, *Thermal stratification, Water circulation, Seasonal variation.

Water temperatures were continuously recorded at 17 sites in Lake Huron during the winter of 1974-75 at depths of 15,25, and 50 m below the surface and 2 m from the bottom. In the beginning of fall overturn in November several warm pulses were observed at depths below 100 m. The shallower southern basin was already isothermal at 7 C. Monthly isotherms followed the bathymetry of the lake. The shore regions rapidly cooled to near freezing by early February. The deep northern basin did not reach a minimum of 1.5 C until mid-April. Differences between mean monthly temperatures at the 15 and 25 m depths were < 0.3 C during December-April. In the deep basins a weak winter thermocline, temperature difference 1.5 C, developed in March and nearly disappeared by April. (Cassar-FRC)
W82-04381

FACTORS REGULATING THE SPATIAL DISTRIBUTION OF THE FILAMENTOUS ALGA PITHOPHORA OEDOGONIA (CHLOROPHYCEAE) IN AN INDIANA LAKE,
Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology.
D. F. Spencer, and C. A. Lembi.
Journal of Phycology, Vol 17, No 2, p 168-173, 1981. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Algal growth, *Lakes, Littoral environment, Littoral zone, Algae, Eutrophication, Nitrogen, Phosphorus, *Nutrients, Limiting factors, Limiting nutrients.

A combined field and laboratory study was designed to determine the factors regulating the spatial distribution of Pithophora oedogonia in Surrey Lake, Indiana. Surrey Lake is small and shallow, man-made, with a water flow from south to north. The inflowing stream drains a watershed of about 1128 ha, 62% of which is agricultural land and pastures, 21% woodland, and 16% residential properties. Water samples and algal biomass samples were collected from May 1978 to December 1979. The biomass was greater in the littoral than in the pelagial region. Although mean soluble reactive phosphorus concentrations did not differ significantly in the open vs cove water, nitrate concentrations were almost six times higher in the latter. Nitrogen limiting conditions were prevalent in the open water section of the lake. Alkaline phosphatase and dark ammonia uptake analyses on field collected filaments from the shallow and deep water sections confirmed the hypothesis that nitrate is the major factor limiting growth of Pithophora in Surrey Lake. (Baker-FRC)
W82-04382

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,
Waterloo Univ., (Ontario). Dept. of Biology.
P. E. Ross, and H. C. Duthie.
Journal of Phycology, Vol 17, No 2, p 181-186, 1981. 5 Fig, 3 Tab, 44 Ref.

Descriptors: *Lakes, *Plankton, Aquatic life, Phytoplankton, Biomass, Photosynthesis, *Canada, Eutrophication, *Lake Matamec, Aquatic productivity, Oligotrophic lakes, *Quebec.

Extremely low phosphorus concentrations were found in Lac Matamec, suggesting that it must be extremely oligotrophic. The summer range of chlorophyll concentrations places the lake among the least productive in the world. Since blue light is attenuated most quickly with depth and red light the least, a characteristic typical of water rich in dissolved humic substances, the lake may also be dystrophic. Further evidence for a dystrophic condition lies in the relationship between chlorophyll a and light extinction. In Lac Matamec there is virtually no correlation between the two parameters of chlorophyll and transparency. The ultraplankton accounted for an average of 47% of the biomass of the lake, but yet was responsible for 71% of the carbon fixation. The ultraplankton had the highest photosynthetic efficiencies of the three classes, ultraplankton, nanoplankton, and plankton. The importance of the ultraplankton in the ecology of Lac Matamec is enhanced by the marked scarcity of littoral habitat. High surface:volume ratios may explain the high efficiency of the ultraplankton. (Baker-FRC)
W82-04383

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,
Kentucky Water Resources Research Inst., Lexington.
J. Calkins, E. Wallingford, and C. Hulsey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211509, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 132, 1982. 59 p, 12 Fig, 1 Tab, 32 Ref. OWRT A-082-KY(1). 14-340001-0119(FY80), 14-34-0001-1119(FY81).

Descriptors: Ecosystems, *Ultraviolet radiation, Ozone, Microorganisms, Thermocline, *Solar radiation, *Plankton, Plankton-sunlight-water movement relationships, Radiation regime, UV-B.

Previous studies have shown the planktonic organisms of various natural water bodies to be quite sensitive to the levels of solar ultraviolet radiation incident at the water surface in summer. It has been assumed that the majority of the phytoplankton are simply carried about in the mass of the water which they inhabit with little controlof their position or sunlight exposure. Photosynthetic microorganisms must strike a delicate balance with regard to solar radiation; they must obtain enough visible light for adequate photosynthesis while avoiding an excessive exposure to the injurious solar UV-B radiation. It is proposed that the circulation in natural waters is such that organisms can 'ride' the current to obtain radiation exposures approximating the average radiation level of the euphotic zone. If exposure tends to become excessive, the plankton 'drop out' of the circulation into the relatively immobile thermocline region until conditionss are favorable for a return to the highly illuminated surface waters. Observations with two

species of aquatic plants generally cofirm the proposed model. A radiation regime where the entire population receives essentially the same exposure to sunlight could be substantially more efficient in using the available light for photosynthesis than the 'static' model where it is assumed that part of the population is overly exposed and another segment continuosly dwells deep in the water in very dim light.
W82-04417

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
For primary bibliographic entry see Field 2B.
W82-04431

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
S. F. Shih, and J. C. Gervin.
Water Resources Bulletin, Vol 16, No 5, p 790-796, October, 1980. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Eutrophic lakes, *Water quality, Light penetration, Regression analysis, Lakes, Mathematical studies, *Turbidity, Water analysis, Opacity, Eutrophication, *Chlorophyll a, *Suspended sediments, Remote sensing, *Landsat, *Lake Okeechobee, Florida.

Studies were made on the eutrophic Lake Okeechobee in Florida to derive a relationship between the chlorophyll a, turbidity and suspended sediment water quality parameters and Landsat radiance values applicable over several days and to compare the regression results for two different levels of accuracy in measuring Landsat radiance values. The general concepts of ridge regression techniques were applied to satellite data analysis. Landsat radiance values processed at a double level of precision gave a better solution when applied to the estimation of water quality parameters. Ridge regression analysis for double level accuracy eliminated problems of multicollinearity and reduced the total mean square error by 13 to 20% and the confidence interval by 6 to 28% when compared to ordinary least square analysis. The stabilized regression equations and individual parameter estimates are more readily interpretable from the standpoint of lake water quality analysis. (Geiger-FRC)
W82-04440

EFFECT OF TEMPERATURE ON HETEROTROPHIC GLUCOSE UPTAKE, MINERALIZATION, AND TURNOVER RATES IN LAKE SEDIMENTS,
Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences.
D. F. Toerien, and B. Cavari.
Applied and Environmental Microbiology, Vol 43, No 1, p 1-5, 1982. 6 Tab, 18 Ref.

Descriptors: *Glucose, *Bottom sediments, *Lakes, Sedimentation, Chemical analysis, Absorption, Metabolism, Mineralization, *Lake Kinneret, *Israel, *Temperature effects, Microbial degradation.

Using sediments from Lake Kinneret, Israel, an evaluation was made of the effect of temperature on the maximum uptake rate, in situ substrate concentration and turnover rate for glucose uptake and mineralization. The major features of Lake Kinneret sediments are a high percentage of fine grain material, an abundance of calcium carbonate, and a dominance of montmorillonite in the clay fraction. The maximum uptake rate was similar when aerobic and anaerobic conditions were used in the assay procedure. The maximum uptake rate values for carbon dioxide evolution (glucose mineralization) ranged from 2.75 to 4.77 micrograms of CO2/g/hr. No consistent pattern was observed in glucose mineralization for the aerobic or anaerobic sediments when assayed aerobically or anaerobically. All temperature experiments were run under aerobic conditions. It was concluded that the maximum uptake rate and the turnover rates of glucose uptake and mineralization were temperature dependent. The glucose respiration/uptake ratio was not greatly influenced by the presence or absence of oxygen or by different assay temperatures. (Baker-FRC)
W82-04466

CONTRIBUTION OF PARTICLE-BOUND BACTERIA TO TOTAL MICROHETEROTROPHIC ACTIVITY IN FIVE PONDS AND TWO MARSHES,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
D. Kirchman, and R. Mitchell.
Applied and Environmental Microbiology, Vol 43, No 1, p 200-209, 1982. 2 Fig, 5 Tab, 46 Ref.

Descriptors: *Ponds, *Bacteria, *Marshes, Ecosystems, Biomass, Particulate matter, Microbiological studies, Coastal mareshes, Salinity, Filtration, Metabolism, Organic compounds, *Coastal waters.

This report compares the number and heterotrophic activity of epibacteria and unattached bacteria in five coastal ponds and two marshes. It is suggested that, although the numbers of epibacteria are low, they may contribute significantly to the turnover of dissolved organic matter in selected aquatic ecosystems. The data presented support the hypothesis that bacteria associated with particulate matter are metabolically more active per cell than unattached bacteria. The particle-bound bacteria incorporated a large proportion of glucose and glutamate in selected aquatic systems. The uptake per cell was significantly higher for epibacteria than for unattached bacteria in all systems. Particle-bound bacteria were more important than total bacteria in those waters with a high particle concentration and not flushed regularly by tides in contrast to waters with a low particle concentration and being flushed regularly. The study indicates that the importance of epibacteria may be greatly underestimated due to their small numbers. (Baker-FRC)
W82-04467

HORIZONTAL DISTRIBUTION AND FLUX OF PHOSPHORUS IN FISH LAKE, WISCONSIN,
Wisconsin Univ.-Madison.
R. J. Erickson.
PhD Thesis, August, 1980. 189 p, 13 Fig, 19 Tab, 110 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28177.

Descriptors: *Lakes, *Littoral environment, *Phosphorus, Sediments, Mass transfer, *Fish Lake, *Distribution patterns, *Wisconsin, Pelagial sources.

Effects of the littoral zone on epilimnetic phosphorus were investigated in Fish Lake, Wisconsin, a mesoeutrophic, calcareous, seepage lake with an area of 88 ha, maximum depth of 19 m, and mean depth of 6.3 m. The littoral comprises 55% of the lake's area and is diverse with respect to sediment texture, angiosperm development, and hydraulic turnover time with the pelagial. Phosphorus concentrations were positively correlated with areas with (a) fine sediment and significant angiosperm development, (b) limited exchange of water with the pelagial, and (c) substantial runoff contributions to sediments. During turnover, pelagial phosphorus concentrations equalled or exceeded littoral concentrations because the hypolimnetic phosphorus pool became a significant phosphorus source to surface waters. Littoral phorphorus concentrations were not correlated with groundwater seepage and showed only a minor response to surface runoff events. This suggests that internal loading from littoral sediments was the major cause of these gradients rather than temporary storage of external loadings. The existence of internal loading was confirmed by observations of phosphorus accretion in littoral enclosures. Littoral-to-pelagial transport was the major phosphorus source to the pelagial during summer stratification, corresponding to 300-1500% of the pelagial phosphorus pool. Net transport of phosphorus from the littoral requires a source of phosphorus to replenish littoral sediments. Measurements in this investigation suggested that external loading was a major immediate source of this phosphorus, but that return of phosphorus from midlake to the littoral during turnover could also be important. (Sinha-OEIS)
W82-04484

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),
Munich Univ. (Germany, F.R.). Geographisches Inst.
For primary bibliographic entry see Field 5B.
W82-04550

SIMULATION AND VERIFICATION OF LAKE ONTARIO'S MEAN STATE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. C. K. Huang, and P. W. Sloss.
Journal of Physical Oceanography, Vol 11, No 11, p 1548-1566, November, 1981. 11 Fig, 2 Tab, 35 Ref.

Descriptors: *Model studies, *Lakes, Thermal stratification, Stratification, *Lake Ontario, Great Lakes, Flow pattern, Wind, Mathematical studies, *Limnology.

A numerical dynamic model was developed for Lake Ontario based on primitive equations. All major current generating mechanisms were taken into account. The model is used for hindcasting the mean state in Lake Ontario during the International Field Year for the Great Lakes (IFYGL). Two simulations were carried out in July and December as representations of summer and winter. One simulation was done under the respective monthly mean steady frocing and the other under the respective hourly, time dependent atmospheric forcing. The constant forcing simulation resulted in a typical two gyre circulation pattern when the wind blew approximately parallel to the major axis of the lake. In the time dependent variable forcing simulation, the high frequency atmosheric fluctuations have not only excited strong inertial motions, but also generated mesoscale eddied near the downwind end boundary. Large scale low frequency topographic waves, propagating cyclonically at a phase speed of 60 cm/second, are also shown in the simulations. the generation, evolution, and dissipation of topographic waves, as well as mesoscale eddies can be expalined satisfactorily by the principle of conservation of potential vorticity. In the July case the lake dynamics are more complicated owing to the presence of thermal stratifications in addition to the mechanical forcing. (Baker-FRC)
W82-04570

STRUCTURE OF THE FLOW WITHIN THE COASTAL BOUNDARY LAYER OF THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
C. R. Murthy, and D. S. Dunbar.
Journal of Physical Oceanography, Vol 11, No 11, p 1567-1577, November, 1981. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Boundary layers, *Lakes, Lake Huron, Boundaries, *Great Lakes, Lake coasts, Flow patterns, Flow, Coastal waters, Nearshore processes, Water currents.

Detailed observations on properties of the nearshore flow were noted at Douglas Point, Lake Huron. A network of current meters deployed in a coastal chain perpendicular to the local shoreline was used to obtain time series flow data. Data from these points was analyzed to resolve the mean flow

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properties, horizontal turbulence characteristics and the kinetic energy within the coastal boundary layer. The variability of these parameters as a function of the distance from shore for an episode during which persistent short-parallel currents prevailed for several days has revealed two distinct boundary layers, an inner boundary layer dominated by bottom and shore friction and an outer boundary layer as a consequence of the adjustments of inertial oscillations to the lateral boundary. If the width of the frictional boundary layer is taken as the distance to the point where the kinetic energy of currents peak, it is about 2 km at Douglas Point. As the width of the inertial boundary layer, the distance to the point where inertial oscillations begin to dominate short parallel flow may be taken. This width at Douglas Point is about 8 to 10 km. (Baker-FRC)
W82-04572

WIND MIXING AND RESTRATIFICATION IN A LAKE NEAR THE TEMPERATURE OF MAXIMUM DENSITY,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
D. M. Farmer, and E. Carmack.
Journal of Physical Oceanography, Vol 11, No 11, p 1516-1533, November, 1981. 13 fig, 2 Tab, 34 Ref.

Descriptors: *Thermal stratification, *Wind, Mixing, Density, *Destratification, *Lakes, Temperature effects, Seasonal variation, Convection, Babine Lake, *British Columbia, Canada.

Wind mixing and restratification were studied under conditions of a density maximum during the cooling of a freshwater lake. A mixed layer model was used to explore the concepts. The model incorporated both nonlinearity and pressure dependence in the equation of state. The results offer a basis for interpreting temperature structure in Babine Lake and for making some more general observations on mixing and restratification. After summer stratification is destroyed by wind mixing and convection in autumn, the lake is essentially isothermal as it cools through 4 degrees C. The coefficient of expansion becomes so small near this temperature that pressure effects which play little part in the dynamics at higher temperatures can dominate the stability. The transition between forced and free convection is marked at the depth where the local temperature equals the temperature of maximum density at constant pressure. Above this transition depth the wind must work against buoyance forces during cooling. Below this temperature the water is gravitionally unstable. Conditional instabilities occur which allow for a downward movement of initially stable water, leading to gravitational instability. As the lake cools the stability becomes less sensitive to pressure, and a given heat flux produces a progressively greater buoyancy flux, leading to the process of restratification. (Baker-FRC)
W82-04573

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,
National Swedish Environment Protection Board, Uppsala (Sweden).
L. Hakanson.
Water Resources Research, Vol 17, No 6, p 1625-1640, December, 1981. 20 Fig, 13 Tab, 31 Ref.

Descriptors: *Sediments, *Lake sediments, *Physical properties, *Path of pollutants, Lakes, Mercury, Organic matter, Nitrogen, Phosphorus, Zinc, Heavy metals, Metals, Nutrients, Model studies, Characteristic values, Statistical analysis, *Sweden.

Characteristic values are determined for physical and chemical sediment parameters in lakes. The various physical sediment parameters (water content, bulk density, organic content, grain siize, degree of compaction, and sediment depth) are related to each other and to the sediment water conoent, a key parameter. The areal distribution of these physical parameters is described by a general formula, which is used with data for 5 Swedish lakes (Hjalmaren, Vanern, northern Vattern, western Malaren, and Ekoln). This relationship provides a way to determine the physically relevant characteristic values, not just traditional statistical values. Results show that (1) the distribution of the physical sediment parameters depends on the water depth, (2) the standard deviation around the mean is large in shallow waters where erosion, transportation, and fine sediments occur, (3) the spread decreases with increasing water depth, and (4) the spread is relatively small at water depths within the zone of accumulation. A formula is given for estimating the critical water content separating areas of accumulation from zones of transportation. Characteristic values may also be determined for chemical parameters showing high correlation with water content (the noncontaminating parameters). This procedure cannot be used on pollutants, which are usually distributed as distinct tongues with concentrations decreasing with increasing distance from the pollution source. Characteristic values for contaminating substances such as mercury may be determined from a map showing the areal distribution pattern as the areal median value. (Cassar-FRC)
W82-04586

BIOGENIC CALCITE STRUCTURES FORMING IN LAKE FRYXELL, ANTARCTICA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. A. Wharton, Jr., B. C. Parker, G. M. Simmons, Jr., K. G. Seaburg, and F. G. Love.
Nature (London), Vol 295, No 5848, p 403-405, February 4, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Polar regions, *Lakes, Calcite, *Lake Fryxell, *Antarctic, Precambrian era, Microorganisms, Sedimentation, Algal growth, Inflow, Meltwater.

Observations in Lake Fryxell, Antarctica, revealed biogenic calcite structures not observed in other studies of Antarctic lakes. These structures were laminated, indurate, unbranched, and had either a vertical or a horizontal orientation. It was inferred that these calcite structures are biogenic in origin, due to the presence of an actively metabolizing algal mat on their surface and an internal composition of filamentous blue-green algal cell wall fragments, diatom frustules and calcite crystals. Lake Fryxell is located at the eastern end of Taylor Valley in southern Victoria Land. The lake lacks outgoing streams, and receives sediment, salts and nutrients from glacial meltstreams during the austral summer. The vertical calcite structures in the lake apparently resulted from the growth of the algal mat in dimly-lit shallow, non-turbulent water. Further study may offer insight into the palaeoecology of Precambrian stromatolites. (Baker-FRC)
W82-04638

PREDICTION OF THE CIRCULATION IN RESERVOIRS,
Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, and D. Pateman.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 427-461, June, 1981. 27 Fig, 20 Ref.

Descriptors: *Reservoirs, *Water circulation, *Wind-driven currents, Lake circulation, *Model studies, Water currents, Coriolis force, Shallow lakes.

Circulation in shallow, open reservoirs was analyzed analytically and experimentally. The theoretical work considered inflows and outflows and geostrophic and wind effects. Experimental work was done on three circular reservoirs with radii of 0.73 to 3.68 m, using dye and illuminated surface floats. In a circular reservoir tangential or radial jets caused circulation patterns dependent on the Reynolds number of the jet and the aspect ratio of the reservoir. Outlet dimensions had little influence on circulation patterns. Circulation was predicted for prototype reservoirs using the equations developed in this paper. Water circulation caused by wind and the earth's rotation were highly dependent on reservoir water depth, wind shear stress at the water surface, and eddy viscosity. Predicted circulation was not applicable to the peripheral areas of the reservoirs. Diagrams for circulation in the experimental reservoirs are given for different combinations of wind stress, eddy viscosity, Coriolis factor, jet velocity, and water depth. (Circulation patterns for two irregularly-shaped reservoirs at Liverpool are also given. (Cassar-FRC)
W82-04682

LIMNOLOGICAL CHARACTERISTICS OF EUTROPHIC LAKE ISTOKPOGA, FLORIDA,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett.
Florida Scientist, Vol 44, No 3, p 172-181, 1981. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Eutrophication, *Limnology, Lakes, Nutrients, Phosphorus, Algal growth, *Lake Istokpoga, *Florida, Field studies, Path of pollutants, Primary productivity, Agricultural runoff, Watersheds.

The results of a comprehensive limnological investigation of Lake Istokpoga are described. This lake represents a significant component of the Lake Okeechobee drainage basin. Nutrient enrichment bioassay experiments are also discussed. The study area is located in Highlands County, south-central Florida, just east of the Lake Wales sand ridge. The surface area is about 112 square kilometers, with a drainage basin of about 1700 square kilometers. The physico-chemical data indicate a well mixed body of water. The large surface area in conjunction with a shallow depth facilitates wind-generated mixing. The influent streams are significant contributors of nutrients to the lake; high primary productivity levels are the result. Irrigation projects contribute significant amounts of nutrients in runoff during dry periods. Nutrient enrichment experiments indicated that primary productivity in the lake was chiefly limited by phosphorus. Seasonal differences in response to ambient algal populations may have been responsible. Taken as a whole, the data suggest that Lake Istokpoga is a eutrophic system. (Baker-FRC)
W82-04719

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,
R. B. Cook.
PhD Thesis, 1981. 267 p, 46 Fig, 45 Tab, 97 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13497.

Descriptors: *Biochemistry, *Lakes, *Sulfur, Bacteria, Sediments, Alkalinity, Chemical reactions, Chemical reduction, Chemical model.

The sulfur cycle in natural systems is greatly influenced by the presence of anoxic zones in which sulfate may be bacterially reduced to form labile H2S. The two lakes examined in this study, Lake 227 and Lake 223 at the Experimental Lakes Area, northwestern Ontario, have seasonally anoxic hypolimnia that exhibit bacterial sulfate reduction. Sulfate reduction rates were estimated from the decrease in hypolimnion sulfate concentrations during thermal and winter stagnation for both lakes and from a water column numerical model in L227. The anoxic breakdown of organic matter, as indicated by NH3 production, liberates S from amino acids and proteins at a rate 1/3 that of sulfate reduction in L227 and 4% of sulfate reduction in L223. Comparison of predicted amounts of FeS precipitated with actually measured FeS shows that there is approximately 3 years accumulation in L223 and greater than 10 years in L227. In L223, all of the FeS that formed during the acidification experiment is present in the sediment. The residence times for sulfate in both lakes are similar to the water residence times (2-6 years). A chemical model has been derived which predicts the increase in alkalinity from ammonia production, sulfate reduction, Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ is lost from the lake system during the invasion of oxygen at fall overturn

when Fe 2+ precipitates as an iron(III) hydroxide. (Sinha-OEIS)
W82-04726

ADDITION OF RADIOCARBON TO THE MIXED-LAYERS OF TWO SMALL LAKES: PRIMARY PRODUCTION, GAS EXCHANGE, SEDIMENTATION AND CARBON BUDGET,
P. M. Bower.
PhD Thesis, 1981. 263 p, 49 Fig, 53 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25254.

Descriptors: *Lakes, *Primary productivity, *Phytoplankton, *Sedimentation, *Carbon cycle, Photosynthesis, Carbon radioisotopes, Mixed layers, Dimictic lakes, Gas exchange.

Addition of radiocarbon to the mixed-layers of two small dimictic lakes had made it possible to assess the validity of enclosing natural phytoplankton populations in bottles for the purpose of estimating primary production. Productivity results for the incubator-model averaged from 0.77 to 0.93 of the whole-lake values depending upon the choice of variables as input to the model. During a period of very high productivity, the 16 hour in situ incubations underestimated the whole-lake results by an average 60%, but the performance of the incubator-model was not affected during this time. Strong surface inhibition of photosynthesis was observed in the vertical profiles of production for the 4 and 16 hour in situ incubations but it was never quantitatively significant for the incubator-model. It is argued that this strong surface depression of photosynthesis is an artifact of the stationary position of the bottles and the unnaturally long exposure to supraoptimal light. A correction for daytime respiration of C14 incorporated on previous days suggests that whole-lake productivity is significantly enhanced over that measured in bottles. The fate of C14 was also monitored in the dissolved inorganic, dissolved and particulate organic, and sediment organic fractions. (Sinha-OEIS)
W82-04730

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W82-04748

2I. Water In Plants

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman, and G. W. Lemert.
Transactions of the ASAE, Vol 24, No 6, p 1533-1538, 1545, November/December, 1981. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Water stress, *Evapotranspiration, *Irrigation requirements, *Sunflower, Seeds, Crop yield, Water requirements, Water use, *Growth stages, North Dakota, Root zone, Plant growth, Soil water.

Water stress was applied to several growth stages of sunflower (hybrid 894): planting to bud, bud to last anther, and last anther to physiologic maturity. Stress level, based on degree of soil water depletion and an allowable level of leaf xylem pressure depression in mid-afternoon, was generally limited to one of the three growth stages. Seed yields vs. seasonal evapotranspiration showed a linear relationship for the upper bound function near 84.3 kg per ha per cm. Maximum yields at two North Dakota sites were 2900 kg per ha (seasonal evapotranspiration, 47 cm) and 3400 kg per ha (seasonal evapotranspiration, 51 cm). On a relative scale the upper bound slope indicated a potential yield loss of 1.3% per 1.0% decline in seasonal evapotranspiration. In this climate near potential yield was attained when available root zone storage capacity was not less than 50-60% in the planting to bud period, 30-40% in the bud to last anther period, and 50-60% in the seed filling period. Reductions of 20% in water requirements are possible with appropriate irrigation regimes. (Cassar-FRC)
W82-04361

EFFECTS OF DECREASED WATERING ON CROP YIELDS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. Sammis, and J. Guitar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211442, Price codes: A03 in paper copy, A01 in microfiche. WRRI Report No 36, August, 1981. 29 p, 3 Fig, 9 Tab, 23 Ref. OWRT-A-063-NMEX(1).

Descriptors: *Alfalfa, *Cotton, *Crop response, Sprinkler irrigation, Lysimeters, Consumptive use, Irrigation deficit, *New Mexico, *Soil-water-plant relationships, Water production function.

Cotton and alfalfa were irrigated for three years at Las Cruces, with a range of water levels using a sprinkler-line source to determine yield and evapotranspiration under deficit irrigation. Alfalfa was grown at five locations and cotton was grown at two locations in New Mexico using flood irrigated nonweighing lysimeters to measure the yield and evapotranspiration under nonlimiting soil-moisture conditions. A linear water-production function was observed for alfalfa. This function appeared to be transferable to any location in New Mexico, based on the data from five locations within the state. The New Mexico relationship was statistically the same as alfalfa water-production functions for Nebraska and North Dakota. A linear water-production function was also observed for cotton, but was applicable only for the two areas in southern New Mexico where the study was conducted. This study indicated that biomass production may require the same amount of evapotranspiration regardless of site and management differences, as in the case of alfalfa, but that lint or seed production per unit of water will vary from place to place and from year to year.
W82-04411

EFFECTS OF SOIL MOISTURE, PLANTING DATE, AND WEEDS ON CEREAL YIELDS (EFFETS DE L'HUMIDITE DU SOL, DES DATES DE SEMIS ET DES MAUVAISES HERBES SUR LE RENDEMENT DES CEREALES),
Department of Agriculture, Sainte-Foy (Quebec).
J. M. Deschenes, and J. P. Dubuc.
Canadian Journal of Plant Science, Vol 61, No 4, p 851-857, December, 1981. 4 Tab, 17 Ref. English summary.

Descriptors: *Irrigation effects, *Soil-water-plant relationships, *Planting management, *Crop yield, Grain crops, *Cereal crops, Wheat, Oats, Barley, Weeds, Plant growth, Soil temperature, *Quebec.

An observed increase in grain yield from early sowing was investigated using two seeding dates (early and late May), two soil moisture levels (natural precipitation and natural plus irrigation with 25 mm of water per week), and three crops (oats, barley, and wheat). Studies were conducted in the field and under greenhouse conditions in Quebec's St. Andre sandy loam during 1976, 1977, and 1979. In the field early seeding plus irrigation increased yields, but the difference in planting time was more significant than the difference in soil moisture levels. Irrigated, late-planted cereals produced 80% of the yield of unirrigated, early-planted cereals. More than 50% of the yield variation was explained by the soil thermal units between sowing and emergence and the total amount of water between emergence and heading. Greenhouse results were similar to field results except that the effect of soil moisture was more evident. Weeds did not play an important role. Best cereal yields in this climate and soil are obtained by cool soil temperatures at seeding and high soil moisture between emergence and heading. Early May sowing fulfills these conditions. (Cassar-FRC)
W82-04470

SORGHUM AND BARLEY IN SOUTHERN ALBERTA: GRAIN YIELD RESPONSE TO IRRIGATION AND FERTILIZER,
Department of Agriculture, Lethbridge (Alberta).
E. H. Hobbs, and K. K. Krogman.
Canadian Journal of Plant Science, Vol 61, No 4, p 837-842, 1981. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Water use efficiency, *Soil-water-plant relationships, *Irrigation requirements, Grain crops, *Sorghum, *Barley, *Alberta, Crop yield, Fertilizers, Plant growth.

Grain sorghum and barley were compared with the respect to seasonal water requirements, interaction between water use and applied N fertilizer, and water use efficiency. Sorghum's seasonal water use was 500 mm, 20% greater than for barley because sorghum's growing season is 2 months longer. Peak daily water uses were 6 mm for sorghum and 5 mm for barley. With adequate irrigation both crops showed a linear yield response to applied N up to 80 kg per ha. However, under dryland conditions fertilizer had little effect on sorghum yield. Water use efficiency decreased with increasing water availability for both crops. Maximum yields were achieved under irrigation. In 1979, a growing season favorable for sorghum (warm fall), water use efficiency was close to 1.25 kg grain per cu m of water for complete season irrigation and early season irrigation regimes for both sorghum and barley. Sorghum grain yield was 6900 kg per ha. In 1978, an unfavorable year for sorghum, water use efficiency (in kg grain per cu m of water) was between 0.5 and 1.0 with or without irrigation; 1.25 for irrigated barley and 2.1 for nonirrigated barley. (Cassar-FRC)
W82-04471

COMPARISON OF PRESSURE CHAMBER AND PSYCHROMETER ESTIMATES OF LEAF WATER POTENTIAL IN RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines).
J. C. O'Toole, and T. B. Moya.
Plant and Soil, Vol 62, No 2, p 313-317, 1981. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water potentials, *Leaves, Experimental design, *Rice, Dewpoint, Hydrometers, Hydrometry, Water analysis, Plant water potential, Measuring instruments.

Two rice cultivars, IR 2035-117-3, a modern semidwarf breeding line from the International Rice Research Institute, and Dular, a tall traditional cultivar from northeast India, were grown in 25 cm deep containers in a well fertilized clay-loam soil. Rice leaves were sampled for water potential between 8 and 9 A.M. on each sample date. Measurements of leaf water potential were made on the two cultivars by two measurement methods, from stress and control treatments and from protected and unprotected leaf handling prior to pressure chamber measurement. Sampling was accomplished over a 26 day period. Protection of leaf samples against water loss during excision, transport and handling was found to be more important at higher leaf water potentials. The two cultivars used appeared to differ in their response to protection of the leaf sample. These results serve to further caution pressure chamber users on extrapolating comparisons between the two measurement methods and between tissue handling techniques even with a single crop species. (Baker-FRC)
W82-04541

ANALYSIS OF THE COMPONENTS OF AREA GROWTH OF BEAN ROOT SYSTEMS,
Science and Education Administration, Fort Collins, CO.
E. L. Fiscus.
Crop Science, Vol 21, No 6, p 909-913, November-December, 1981. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Roots, *Water transport, *Plant water potential, Condutance, *Plant growth, *Beans, Hydraulic properties.

Root and shoot growth data are presented for Phaseolous plants grown under two conditions of

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light intensity, and discussion is offered on how the distribution of various sizes of roots and their maturation might be related to the mean water transport coefficients and the growth rates for the whole root system. Plants were grown in aerated nutrient solution for 41 days in a greenhouse, under two light intensities, 425 and 300 microE/square meter/second. Determinations were made of leaf area, root area ratios, distribution of root sizes, and the fraction of the total root surface area of each root class. For plants with leaf and root areas greater than 1000 square centimeters, all of these parameters remained stable. They were not changed by light intensity or by growth rate. The mean root system hydraulic conductance appeared to be related to plant size rather than to plant age. In small plants the conductance was very low. Conductance increased about sixfold and peaked when the root systems reached about 1000 square centimeters in surface area. When the root size distribution stabilized in plants larger than 1000 square centimeters conductance gradually declined, probably because of suberization or some other growth related factor. The same pattern of relationships between root system size, root size distribution and hydraulic conductance was noted in plants grown at lower light intensity, except that the overall hydraulic conductance was consistently lower for plants of similar sizes. (Baker-FRC)
W82-04715

2J. Erosion and Sedimentation

TRANSVERSE BED SLOPE IN ALLUVIAL CHANNEL BENDS,
Iowa Univ., Iowa City. Inst. of Hydrological Research.
A. J. Odgaard.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1677-1694, December, 1981. 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Sediment transport, *Slope degradation, *River beds, *Model studies, *Channel erosion, Channel morphology, Channel flow, Banks, Stream erosion, Streambeds, Sacramento River, Shear stress, Particle size, Alluvial channels, Bed load.

Existing models for the prediction of the steady-state transverse bed slope in channel bends and an alternative model developed in this paper were compared using laboratory and field data from the Sacramento River. Flows in alluvial channel bends are difficult to describe because of the helical flow pattern in the bend and its interactionwith the topography of the channel bed. Strong secondary currents combined with a transverse slope of the bed, deeper toward the outer bank, undermine and erode the outer bank. Existing models are based on equations of motion for the sediment particles in the bed load, whereas the writer's model is based on the assumption that the bed topography is determined by the critical conditions for sediment entrainment. All models gave reasonable agreement between measured and predicted slopes at smaller transverse slopes. At larger slopes the writer's model and one other were the only ones giving acceptable agreement. Grain size is a key parameter in all models, but there is no technique which can simulate the spatial variation of the grain size. (Cassar-FRC)
W82-04366

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8D.
W82-04368

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
J. E. Evans, T. C. Johnson, E. C. Alexander, Jr., R. S. Lively, and S. J. Eisenreich.
Journal of Great Lakes Research, Vol 7, No 3, p 299-310, 1981. 4 Fig, 4 Tab, 47 Ref.

Descriptors: *Sedimentation rates, *Lake sediments, Lakes, *Lake Superior, Lake basins, *Trace metals, Shores, Storms, Erosion, Sediment cores, *Cores, Sediment sampler.

Sedimentation rates in Lake Superior ranged from 0.01 to 0.32 cm per year as determined by Pb210 geochronology of 17 sediment box cores taken in representative locations. The western arm of the lake had moderate to high sedimentation rates (0.05-0.11 cm per year), caused by shoreline erosion and resuspension of nearshore sediments. Marginal bays adjacent to the lake had the highest rates (>0.15 cm per year). Open lake regions adjacent to marginal bays had slightly lower rates (0.07-0.19 cm per year). Lowest sedimentation rates (0.01-0.03 cm per year) were in the central basins, which are isolated from sediment sources. Anomalies in Pb210 profiles in the southern and southeastern lake correspondended with severe storms in 1905, 1916-1918, and 1940, the severest storm of the century. These sediment disturbances were produced by resuspension of nearshore and shoal top sediments. Pb210 flux rates range from 0.2-10.0 dpm per sq cm per year, higher than those reported for other lakes. Possible reasons for this are: (1) higher atmospheric deposition rates from uranium bearing rocks or (2) samples collected in shore regions in this study. (Cassar-FRC)
W82-04380

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,
Illinois Natural History Survey, Chicago.
For primary bibliographic entry see Field 5C.
W82-04389

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
J. R. Gosz, C. S. White, and P. F. Ffolliott.
Water Resources Bulletin, Vol 16, No 5, p 927-933, October, 1980. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Sediment transport, *Chemical analysis, *Phosphorus, Trace metals, *Heavy metals, *Nutrients, Watersheds, Geology, Pine trees, New Mexico, Arizona, Solute transport, Soil types, Vegetation, Comparison studies.

This paper reports on a preliminary test of the hypothesis that sediment of a given size classification derived from small watersheds of uniform bedrock and a single vegetation type would have a uniform nutrient and heavy metal transport capacity. A comparison was made of samples from ponderosa pine communities growing on basalt, sandstone, limestone, and granite bedrock, and a comparison was made between a ponderosa pine community and a mixed conifer community on basalt bedrock. Analyses of acid-digestable and extractable nutrients showed differences for sediments derived from ponderosa pine forests in the Southwest on different geologies. These differences were similar for soil, stream bank, and stream channel material from a given site. Suspended sediment collections had nutrient concentrations similar to those of stream channel collections. Different vegetation on a given geology affected primarily the organic matter content, cation exchange capacity, total phosphorus, and levels of extractable nutrients in sediment. With additional work on other vegetation associations and a larger number of examples for a given bedrock, this approach may allow reasonable estimates of element loss from watersheds, knowing only bedrock composition, vegetation association, and sediment output. (Baker-FRC)
W82-04437

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,
Science and Education Administration, Athens, GA.
For primary bibliographic entry see Field 7B.
W82-04438

RESERVOIR SEDIMENTATION WITH RANDOM DEPOSITS,
Asian Inst. of Tech., Bangkok. (Thailand).
H. N. Phien, A. Arbhabhirama, and P. Chenyapanich.
Water Resources Bulletin, Vol 16, No 5, 2 Tab, 13 Ref.

Descriptors: *Sedimentation, *Mathematical models, *Sediment discharge, *Reservoirs, Mathematical studies, Model studies, Statistical models, Statistical methods, Markov process, Sediment load, Sediment distribution, Sediment yield.

The volume of sediment accumulated in a reservoir over a period of years was considered as the sum of the annual sediment volumes for those years, which are obtained using the correlation between sediment discharge and river discharge and are treated as random variables in a statistical analysis. If longer records of stream flows are available, the relationship between sediment load and river discharge may function as a transformation of variables by which the distribution of sediment discharge (S) is transferred from the distribution of river discharge (Q). The relationship between these variables may also serve as a data generating system which provides a sediment S-sequence of the same length as the river discharge Q-sequence. Assuming the S- and Q-sequences follow a log-normal distribution, the mean and variance of the sediment volume accumulated in the design was applied to case studies at Kang Khoi on the Pasak River and at Nawarat Bridge on the Ping River, good agreement between values of the S- and Q-sequences were found. (Geiger-FRC)
W82-04443

RESERVOIR SEDIMENTATION AND ITS CAUSES IN ILLINOIS,
Illinois State Water Survey, Urbana.
J. B. Stall, and M. T. Lee.
Water Resources Bulletin, Vol 16, No 5, p 874-880, October, 1980. 6 Fig, 6 Tab, 10 Ref.

Descriptors: *Reservoirs, *Sedimentation, Sedimentation rates, Reservoir silting, Watersheds, Soil erosion, Lakes, *Illinois, Model studies, Computers.

The objectives of this paper were to provide for the state of Illinois a summary of the rates of destruction of impounding reservoirs by sediment deposition; to illustrate the use of the Universal Soil Loss Equation (USLE) to calculate soil losses from every farmer's field, from subwatersheds, and from an entire drainage area; to illustrate a sediment source map for an entire watershed; and to show how this sediment source map can be used to identify areas of the watershed where soil losses are excessive. Detailed surveys were made on 107 lakes. A generalized graph allows annual reservoir capacity loss in percent to be estimated based on size of watershed, lake capacity and watershed ratio. For the 258 square miles of land on the watershed of Lake Springfield, complete soil maps were measured using a graphic digitizer. A computer readable map was produced. The USLE was solved to provide upland soil losses for each area of the watershed. Average watershed soil loss was 3.96 tons per acre per year, and 24% of this was delivered to the lake, meaning that a representative lake in Illinois would have a normal life of 161 years. (Baker-FRC)
W82-04450

BANK FAILURE AND EROSION ON THE OHIO RIVER,
Louisville Univ., KY. Dept. of Civil Engineering.
D. J. Hagerty, M. F. Spoor, and C. R. Ullrich.
Engineering Geology, Vol 17, No 3, p 141-158, 1981. 9 Fig, 3 Tab, 6 Ref.

Descriptors: *Bank erosion, *Mechanical failure, *Erosion, River flow, *Ohio River, Navigation,

Locks, Water level, Boats, Washouts, Infiltration, Land use, Alluvial deposits, Drainage.

Large numbers of riparian landowners along the Ohio River have complained that bank failures and erosion have been caused and/or accelerated by the existence of navigation-aid structures as well as prop turbulence and wave-related erosion by river traffic. Therefore studies were conducted on failure and erosion as well as on river regulation mechanisms. Paintings, photographs and reports revealed a history of significant bank erosion on the Ohio River for more than 150 years, primarily related to storms and high water periods. Construction of larger dams and locks raised retained water levels in some areas. No correlation was found between the ages of given pools and the apparent severity of erosion. During low to moderate flows water levels in the upstream reaches of navigation pools fluctuate somewhat more frequently than water levels immediately upstream from the dams, but fluctuations are smaller than those which occurred prior to dam construction. Based on reconnaissance surveys, bank failure and erosion were found to be a function of bank materials, topography, land use, river morphology and weather cycles. The phenomena are episodic and complex. The principal erosion mechanism appears to be bank material removal by current tractive forces during flood events and internal erosion of bank materials by bank discharge following floods. Landslides at several sites were triggered by periods of greater than average precipitation. Changes in drainage and land use which increase infiltration behind river banks could accelerate this internal erosion mechanism. No significant correlation was found between boat traffic level and bank erosion, but significant site-specific effects are possible. (Carroll-FRC)
W82-04473

EROSION AND SEDIMENTATION IN THE KENAI RIVER, ALASKA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
K. M. Scott.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.25. Geological Survey Professional Paper 1235, 1982. 35 p, 19 Fig, 5 Tab, 53 Ref.

Descriptors: *Streams, *Channel erosion, *Bank erosion, *Sedimentation, Watersheds, Flow characteristics, Snowmelt, Floods, Bed load, Gravel, Vegetation effects, Fisheries, Salmon, Hydrographs, Aerial photography, *Alaska, *Kenai River.

The Kenai River is the most important freshwater fishery in Alaska. The flow regime is characterized by high summer flow of glacial meltwater and periodic flooding caused by sudden releases of glacier-dammed lakes in the headwaters. Every part of the stream is a known or potential salmon-spawning site. The stream channel is underfit, attributed to regional glacial recession and drainage changes, and locally is entrenched in response to geologically recent changes in base level. Throughout the central section of the river the channel is armored, a condition with implications for the ability of this section of channel to support the spawning and rearing of salmon. The entrenched section of the channel has been stable since 1951. Bank erosion is active both upstream and downstream from the entrenched channel, however. Although erosion rates have been generally constant since 1951, evidence suggests a possible recent decrease in bank stability that may be related to changes in river use. As population and recreation use increases, development can pose a hazard to the productivity of the stream through increased suspended-sediment concentration resulting directly from construction and, with greater potential for long-term impact, indirectly from bank erosion. A short-term hazard to both stream and developments is the cutoff of meander loops, the risk of which is increased by canals and boat slips cut in the surface layer of cohesive, erosion-resistant sediment on the flood plain within nonentrenched meander loops. A long-term hazard is an increase in bank erosion rates resulting from loss of vegetation on the high (up to 70 feet) cutbacks of entrenched and partially entrenched section. (USGS)
W82-04495

ANASTOMOSED RIVER DEPOSITS: MODERN AND ANCIENT EXAMPLES IN ALBERTA, CANADA,
Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith, and P. E. Putnam.
Canadian Journal of Earth Sciences, Vol 17, No 10, p 1396-1406, October, 1980. 7 Fig, 1 Tab, 41 Ref.

Descriptors: *River beds, *Sediments, *Sedimentation, River basins, Wetlands, Channel flow, Aggrading rivers, Anastomosed deposits, *Canada, Alexandra River, Alluvial deposits, *Braided streams, Alberta, British Columbia.

Anastomosis is suggested as an alternative fluvial system to those of deltaic, braided, and meandering for the deposition of some thick fluvial deposits located in Alberta and British Columbia. An anastomosed fluvial system is a low energy complex of several interconnected channels of variable sinuosity crossing a wetland and forming many elongate vegetated islands. The causal mechanism is either a rising local base level control downriver, or a subsidence of the depocentre relative to a downriver reach. Modern and ancient examples of anastomosis are described to provide a basic depositional framework. One modern example is the lower reach of the Alexandra River in Banff Park. Ancient examples occur in east central Alberta and southwest Saskatchewan. Anastomosed systems have only recently been recognized as a unique fluvial style related to specific causal conditions. Much more field work on modern examples is necessary. (Small-FRC)
W82-04531

HOW RAIN INTENSITY AFFECTS INTERRILL EROSION,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer.
Transactions of the ASAE, Vol 24, No 6, p 1472-1475, November/December, 1981. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Rain intensity, *Erosion, *Sediment transport, Clays, Soil types, *Rill erosion, Soil erosion, Interrill erosion, Runoff, Cropland, Sediment yield, Cultivation, Vegetation effects.

Artificial rainfall was applied to crop row side slopes in fields to determine the effects of rain intensity on interrill erosion. Study sites were farm fields in Mississippi and Iowa. Different soils and cropping conditions were used in the investigation. An equation, $E = aI$ to the b power, where E = erosion rate, a = coefficient of best fit, I = rain intensity, and b = exponent of best fit, was suitable for a wide range of soils and cropping conditions. The exponent b decreased from 2.0 for soils of low clay content to 1.6 for soils with 50% clay. This showed that the influence of rain intensity on erosion was greater for low-clay soils than for high-clay soils, possibly because of greater soil cohesiveness in the higher-clay soils. The equation $E = cI$ squared, where c = ratio of coefficients, fit the data for high clay soils. The relative interrill erodibilities of the different soils or the relative erosion from different cropping conditions are quantitatively indicated by c. (Cassar-FRC)
W82-04537

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,
Science and Education Administration, Fort Collins, CO.
R. E. Smith.
Transactions of the ASAE, Vol 24, No 6, p 1508-1514, November/December, 1981. 11 Fig, 20 Ref.

Descriptors: *Sediment transport, *Surface runoff, *Strip mines, Sediment yield, *Model studies, *Colorado, *Watershed management, Erosion, Sedimentation ponds, Ponds, Hydrologic models, Runoff, Snowmelt, Land treatment, Vegetation effects, Simulation.

A general watershed runoff and sediment transport model, KINEROS, is given for managing watersheds. Although the model can be applied to a wide range of situations from small urban regions to agricultural watersheds, this paper features its application to a watershed disturbed by surface mining. The major components are infiltration, surface water flow, channel flow, sediment transport, and pond storage. The model is applied to a steep 22-ha watershed established in a strip mine region in western Colorado. Measured and simulated runoff from two summer storms in August 1979 agreed well. Simulation of the April 19, 1979, snowmelt did not produce results comparable to the observed sediment concentrations. Modeling of a sedimentation pond, not yet in operation, indicated the effects of different treatments of surrounding land, such as terraces and vegetative cover. More suitable transport equations are needed for predicting sediment transport on steep watersheds with fine sediments. (Cassar-FRC)
W82-04552

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2B.
W82-04617

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,
Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
For primary bibliographic entry see Field 8B.
W82-04642

MATHEMATICAL SIMULATION OF SEDIMENT MOVEMENT IN STREAMS,
Hydraulics Research Station, Wallingford (England).
R. Bettess, and W. R. White.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 879-892, September, 1981. 4 Fig, 14 Ref.

Descriptors: *Sediment transport, *River beds, Sediment sorting, *Model studies, Bed load, Milburn Dam, *Nebraska, *Middle Loup River.

A model for sediment movement in streams was developed and used to predict changes in bed loads and changes in the composition of the bed materials over periods of several years. The model is one-dimensional and time-dependent, and all river properties such as discharge, stage, and bed level, depend only on two variables: the distance along the river and the time. Satisfactory results were obtained when the model was applied to two problems: a laboratory flume test and a field test of a 5200 m reach of the Middle Loup River downstream of Milburn Dam, Nebraska. The observed and calculated bed levels directly downstream of the dam in 1964 were about 1 m less than the original 1961 bed level. (Cassar-FRC)
W82-04650

GROUND-WATER FLOW SYSTEMS AND STABILITY OF A SLOPE,
Woodward-Clyde Consultants, San Francisco, CA.
R. J. Sterrett, and T. B. Edil.
Ground Water, Vol 20, No 1, p 5-11, 1982. 12 Fig, 10 Ref.

Descriptors: *Beach erosion, *Great Lakes, *Artesian pressure, *Groundwater movement, *Slope stability, Erosion, Bank erosion, Slope degradation, Artesian flow, Confined aquifers, Shore protection, Piezometers, Pore pressure, Geologic fractures, Canada, United States.

Receding shorelines along the Great Lakes have resulted in millions of dollars worth of property damage in the United States and Canada. Various projects that have investigated this erosion problem have shown that wave action at the base of the bluff is the main cause of bluff-top retreat. A study of the physical processes which cause bluff erosion

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was undertaken with special focus on the role of groundwater in bluff stability. In one section of the Lake Michigan shoreline, an annual bluff-top recession of 9 to 10 m was recorded that was not related to toe erosion. Heads were measured in 25 piezometers at the site and a complex groundwater flow system was found. A glacial sand unit under artesian pressure was detected 5 m above the toe bluff while another 'perched' system existed in a fractured till unit at the top of the bluff. Fluctuations of up to 13 m/year which were recorded in the lower sand unit significantly affected bluff stability. Field data of pore pressures and calculations of the effective strength values of soil units were utilized in slope stability determinations to estimate safety factors. (Geiger-FRC)
W82-04677

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. El Sabrouti, and A. A. Sokkary.
Marine Geology, Vol 45, No 1/2, p M15-M21, 1982. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Diagenesis, *Clays, *Sediments, Shallow lakes, *Lake sediments, Bottom sediments, Organic acids, Organic matter, Montmorillonite, Kaolinite, Illite, Nile Delta, *Lake Edku, Lagoons, Egypt.

Analyses of seven core samples from bottom sediments in Lake Edku, west of the Nile Delta, indicated that these sediments were derived from the Nile River, not from wind-transported sediments. This coastal lagoon varies in depth from 10 to 140 cm and receives inflow from the Mediterranean during dry periods. The major contituent of the sediments was montmorillonite, 47-80%. Illite and kaolinite were present at 7-37% and 6-29%. The proportion of montmorillonite increased and the proportion of illite decreased with increasing sediment depth. Kaolinite also decreased with depth, but to a smaller degree, 4-12%. It is believed that some of the illite was diagenetically changed to montmorillonite through the action of organic acids formed through decomposition of organic matter in the bottom sediments. (Cassar-FRC)
W82-04748

2K. Chemical Processes

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,
Department of the Environment, Vancouver (British Columbia).
P. H. Whitfield, and H. Schreier.
Limnology and Oceanography, Vol 26, No 6, p 1179-1182, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Water chemistry, *Hysteresis, *Fraser River, Rivers, Sampling, Sample preparation, Water sampling, Monitoring, Water quality, Discharge measurement, Load distribution, *British Columbia, *Streamflow-water quality relations.

Analysis of water samples taken from the Fraser River showed a general hysteresis in the discharge-concentration relationship recurring from year to year, with an overall pattern which was remarkably consistent over a 4 year period. The shape of the hysteresis changed more dramatically from one sampling station to another than from year to year. If the hysteresis were symmetrical the overall regression equation would balance the seasonal over- and under-predictions. However, most of the loops are asymmetrical, and yearly predictions thus become more complex and less accurate. Many properties showed hysteresis development when plotted against discharge. Differences were noted not only in the shape of the hysteresis but also in the direction. At some stations the loop developed in a clockwise direction, while in others it was counterclockwise, and in some it crossed over. Several different processes influence the development and shape of the hysteresis, and thus it is not possible to develop a universal model for predicting loadings in the entire river basin. Different rates of nutrient cycling, biological uptake, storage-discharge relationships, and factors relating to climatic and cyclic events are in part responsible for creating a hysteresis. To avoid statistical problems related to serial correlations and hysteresis a complex sampling design is needed, where samples are collected at equal spaces in time and at equal increases in discharge volume. Samples need to be taken often enough to include individual events of high discharge. (Baker-FRC)
W82-04326

WATER CHEMISTRY OF THE ILLINOIS WATERWAY,
Illinois State Water Survey Div., Champaign.
V. Kothandaraman, R. A. Sinclair, and R. L. Evans.
Circular 147, 1981. 23 p, 6 Fig, 15 Tab, 12 Ref.

Descriptors: *Chemical analysis, Physical analysis Water sampling, Streams, *Waterways, Water quality, Data collections, Alkalinity, Dissolved oxygen, Chlorides, Suspended solids, Water temperature, Orthophosphates, Ammonium compounds, Nitrogen compounds, Nitrates, Fluctuations, *Baseline studies, *Lake Michigan, *Water diversion, *Illinois waterway.

A two-year field sampling effort was undertaken by the Illinois State Water Survey to develop baseline water chemistry data prior to increased diversions of Lake Michigan waters into the Illinois Waterway, and to assess the probable impact of the diverted waters on the water chemistry of the waterway. Physical and chemical water quality characteristics are summarized from data obtained at 28 sampling locations established at 10-mile intervals and covering about 270 miles of the waterway. Observations and samples were used to determine temperature, dissolved oxygen (DO), turbidity, pH alkalinity, hardness, chlorides, total solids, suspended solids, orthophosphate-phosphorus, total phosphate-phosphorus, ammonium-nitrogen, and nitrate nitrogen. The waterway was divided into seven reaches and data within each were combined. The Illinois Waterway is high in alkalinity, total solids, and hardness. The pH samples varied from 7.6 to 9.3---within established limits of the Illinois Pollution Control Board. Alkalinity and hardness increased as the river flowed downstream. Ammonia concentrations were higher in the upper reaches of the river as were DO levels. Long-term average mineral and nutrient transports at three USGS gaging stations were made by the flow duration curve method. Nitrate flux at the stations varied from 8.88 to 13.83 lbs/ac/yr and are in the mid-range of values reported for other Illinois streams. Phosphorus loads varied from 1.20 to 2.96 lbs/ac/yr which are several times higher than the values reported for other Illinois streams. (Atkins-Omniplan)
W82-04390

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04519

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,
Indo-British Betwa Groundwater Project, Bhopal (India).
For primary bibliographic entry see Field 2B.
W82-04666

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
A. K. Mukherjee, and K. Nand.
Mausam, Vol 32, No 3, p 231-236, July, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Rain, *Carbon dioxide, *Hydrogen ion concentration, *India, Tropical regions, Monsoons, Solubility, Temperature, Air temperature.

Differences in pH of rainwater between northern European countries and tropical countries are explained with respect to the solubility of carbon dioxide at different temperatures. The theoretically calculated pH at 20 C is 5.65, based on the assumption that dissolved carbon dioxide is in equilibrium with atmospheric CO2. The pH of rainwater in India is close to neutral, 7.0. In colder European countries the solubility of CO2 in water is about 1.5 times that in the tropics. In addition, the dissolution rate of CO2 in rainwater is about 1.5 times higher in the colder countries. In the tropics the higher atmospheric temperature, lower solubility and dissolution rate of CO2, and the rapid cloud formation and precipitation result in a higher pH. (Cassar-FRC)
W82-04669

GEOCHEMISTRY OF THERMAL AND MINERAL WATERS IN THE CASCADE MOUNTAINS OF WESTERN NORTH AMERICA,
Oregon Water Resources Dept., Salem.
L. S. Forcella.
Ground Water, Vol 20, No 1, p 39-47, 1982. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Thermal springs, *Thermal properties, *Chemical properties, *Mineral springs, Hydrogen ion concentration, Ions, Water properties, Geohydrologic units, Geohydrology, Geothermal studies, Geothermal resources, Mineral water, Geophysics, *Cascade Mountains, Washington, Oregon.

The chemistry of thermal and mineral waters in the Cascade Mountains was examined as a basis for future comparisons with other hydrothermal systems and for future development of geothermal resources. The thermal and mineral waters from the Cascades may be classified into three chemically distinct groups. Group 1 exhibits a neutral pH, an average total dissolved solids (TDS) value of 2650 ppm, and dominant Na and Cl ions. Group 1 waters issue from the geothermally attractive Central Cascades and were probably in prolonged contact with Eocene marine sediments during the Mesozoic era. Group 2 waters are fumarolic acid-sulfate waters from the vents of Mt. Lassen, Newberry Crater and Mt. Hood. Basic brines discharge from the base of Mt. Lassen and Mt. Hood. The Group 3 waters are characterized by chemical inhomogeneity between different points of discharge. Dominant ions are Cl, Na, HCO3, and SO4 and the pH ranges from 6.2 to 9.7. The thermal waters of the Cascade Province have been subject to various degrees of mixing and proximity to heat which might account for the chemical differences. (Geiger-FRC)
W82-04673

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-04720

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,
For primary bibliographic entry see Field 2H.
W82-04726

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,
Arizona State Univ., Tempe. Dept. of Geology.
L. P. Knauth, M. B. Kumar, and J. D. Martinez.
Journal of Geophysical Research, Vol 85, No B9, p 4863-4871, September 10, 1980. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Geochemistry, *Isotope studies, *Salt domes, Meteoric water, Chemical composition, Oxygen, Hydrogen, Salt mines, Saline water, Groundwater, Louisiana, *Gulf of Mexico, Weeks Island, Jefferson Island, Belle Isle.

Water has occasionally been found to enter newly excavated chambers in salt domes along the northern coast of the Gulf of Mexico from ceiling drips,

wall seeps, and exploratory boreholes. An understanding of the origin of this water is extremely important in evaluating the suitability of salt domes as isolation sites for nuclear waste proucts. Possible origins include connate waters that have been in the salt since deposition and waters external to the dome which have somehow penetrated or become incorporated into the salt. The hydrogen and oxygen isotopic composition of water samples collected from salt mines on Weeks Island, Jefferson Island, and Belle Isle in southern Louisiana were analyzed in an effort to determine the origin of the water. Two samples were found to be isotopically similar to local surface waters and clearly of meteoric origin. All of the other samples were too enriched in oxygen-18 to be meteoric waters. Water derived from active leaks in three mines on Weeks Island was too enriched in oxygen-18 and too depleted in D to be connate ocean water or evaporite connate water trapped in the salt. It is unlikely that the water originated from the dehydration of gypsum or that isotopic exchange with anhydrite is responsible for the oxygen-18 enrichments. It is concluded that the nonmeteoric waters are saline formation waters which have become incorporated in the salt. The observed oxygen-18 enrichments suggests that the formation waters were incorporated during diapiric rise of salt at a depth of 3 to 4 kilometers and have been trapped within the salt for between 10 and 13 million years. The presence of limited amounts of such trapped formation water in the salt within salt domes will have to be considered when planning radioactive waste storage in salt domes. (Carroll-FRC)
W82-04742

2L. Estuaries

SURVIVAL AND HETEROTROPHIC ACTIVITIES OF FRASER RIVER AND STRAIT OF GEORGIA BACTERIOPLANKTON WITHIN THE FRASER RIVER PLUME,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
M. Valdes, and L. J. Albright.
Marine Biology (Berlin), Vol 64, No 3, p 231-234, 1981. 9 Fig, 3 Tab, 40 Ref.

Descriptors: *Nutrients, *Plumes, Rivers, Carbon, Nitrates, Phosphorus, *Bacteria, *Estuaries, Plankton, Fraser River, Strait of Georgia, *British Columbia, Canada.

Subsurface samples of water were taken from various locations in the Fraser River, its plume and the Strait of Georgia and use for experimental purposes within 1 hr of collection. The majority of the autochthonous heterotrophic bacterioplankton of the lower Fraser River appeared to be killed when placed in marine water taken from the Strait of Georgia. However, their marine counterparts with Strait of eorgia surface water remained viable when treated with Fraser River water. Within the plume water a stimulation of glucose heterotrophic activity occurred within the salinity range of about 3-18 0/00. The plume water itself arises naturally when the freshwater of the Fraser River mixes with the marine water of the Strait of Georgia. This increase in bacterioplankton activity may be a result of a better nutrient environment within plume water as compared to either parent water. It is noted that there is a well distributed and relatively high inorganic carbon, nitrate and phosphorus content in the plume water, which makes it more nutritionally complete for acteria than either of the other waters. (Baker-FRC)
W82-04291

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 7B.
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,
North Carolina State Univ. at Raleign. Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W82-04297

THE EFFECT OF DRIED AND CRACKED SEDIMENT ON THE AVAILABILITY OF PHOSPHORUS IN A COASTAL LAGOON,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Biologia.
V. Arenas, and G. De La Lanza.
Estuaries, Vol 4, No 3, p 206-212, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Lagoons, *Phosphorus, Nutrients, Estuaries, Estuarine environment, Cycling nutrients, *Mexico, Coastal waters, Water level, Aquatic plants, Sediments, *Caimanero Lagoon, Dry sediment.

The effect of dried and cracked sediments on the availability of nutrients such as phosphorus in coastal ecosystems was investigated. The study area was the Caimanero Lagoon, which is subject to alternate periods of low water and flooding. In times of low water, more than 70% of the lagoon area is dry, cracked and colonized by halophytes to variable proportions. Mineralization of organic matter occurs during these dry times and reavailability of phosphorus takes place to a great extent. The amount of soluble organic matter also increased during the dry seasons. It was established that the sedimentary drying and cracking process contributed significantly to estuarine productivity, probably due to the ability of algae to utilize the phosphorus from organic sources. (Baker-FRC)
W82-04299

OREGON COASTAL SALT MARSH UPPER LIMITS AND TIDAL DATUMS,
Oregon State Univ., Corvallis.
R. E. Frenkel, H. P. Eilers, and C. A. Jefferson.
Estuaries, Vol 4, No 3, p 198-205, 1981. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Salt marshes, Coastal zone management, Wetlands, *Tidal marshes, Marshes, *Oregon, *Coastal marshes, *Saline-freshwater interfaces, Saline water intrusion.

Independent surveys were made of three coastal salt marshes to determine the upper limit of marsh. The areas of study included South Beach marsh of the Yaquina River estuary, Drift Creek marsh of the Alsea River estuary, and Bandon marsh of the Coquille River estuary. Primary tidal data are relatively infrequent for the Oregon Coast. Of the marshes studied, only South Beach had dependable data. The relation of tidal datum planes to National Geodetic Vertical Datum (NGVD) was not readily available and was determined from vertical control data for bench marks. A transition zone between marsh and upland was identified by strong dominance of Potentilla pacifica and the presence of Achillea millefolium, Angelica lucida, Aster subspicatus, Oenanthe sarmentosa, Trifolium wormskjoldii, and Vicia gigantea. The mean elevation of the lower boundary of the transition zone was 1.38 meters above NGVD and the upper boundary of the transition zone was 1.54 meters above NGVD. The relation of the upper limit of marsh to tidal datums varied with marsh. The mean elevation of the upper and lower limit of the transition zone was 0.58 meters above MHW and 0.36 meters above MHW, respectively. Two teams of biologists using the same biological criteria for defining the upper limit of marsh independently agreed on the elevational position of the upper limit of marsh. Additional research on defining the upper limit of coastal marsh is needed.
W82-04312

NUTRIENT MASS BALANCES FOR THE WATERSHED, HEADWATERS INTERTIDAL ZONE, AND BASIN OF THE RHODE RIVER ESTUARY,
Chesapeake Bay Center for Environmental Studies, Edgewater, MD.
D. L. Correll.
Limnology and Oceanography, Vol 26, No 6, p 1142-1149, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Nutrients, Nutrient removal, *Rhode River Estuary, Maryland, Rivers, Cycling nutrients, Organic matter, Nitrogen, Phosphorus, Seasonal variation, Path of pollutants.

Measurements were made of the dynamics of nitrogen, phosphorus, and organic matter content in the basin, headwaters, intertidal zone and watershed of the Rhode River Estuary. Inputs from precipitation and both surface and groundwater runoff were measured continuously, as well as the tidal flux between the intetidal zone and the main estuarine, open water basin, for a 13-month period. The watershed is dominated by agriculture and secondary successional vegetation, 88 ha of todal marshes and mudflats, and an estuarine open water basin. Less organic matter moved out to the estuary than was discharged into the intertidal zone from the watersheds and deposited in precipitation. Only 1.9 tons of the 2.7 tons of phosphorus discharged from the uplands into the intertidal zone moved into the estuary. In most instances a high discharge of phosphorus from the watersheds was followed in a week or two by a high discharge into the estuary from the intertidal zone. A significantly lower fraction of the total phosphorus moving into the estuary was made up of orthophosphate than had been anticipated based on the amount of orthophosphate moving from the watershed. Of the 10 tons of nitrogen discharged from the watershed into the intertidal zone, only 7.4 tons moved into the estuary. Thus overall removal and storage of nutrients from land runoff by the intertidal zone is apparent. Only when runoff was high due to storms were some of the stored nutrients flushed from the intertidal zone. (Baker-FRC)
W82-04330

VERTICAL MIXING AND PHOTOSYNTHETIC CAPACITY OF ESTUARINE PHYTOPLANKTON (MELANGE VERTICAL ET CAPACITE PHOTOSYNTHETIQUE DU PHYTOPLANCTON ESTUARIEN (ESTUAIRE DU SAINT-LAURENT)),
Laval Univ., Quebec. Dept. de Biologie.
S. Demers, and L. Legendre.
Marine Biology (Berlin), Vol 64, No 3, p 243-250, 1981. 5 Fig, 45 Ref. English summary.

Descriptors: *Estuaries, *Phytoplankton, Vertical distribution, *St. Lawrence Estuary, Vertical distribution, Chlorophyll, Photosynthesis.

Water samples were collected hourly for 167 hours in August of 1975 at an anchor station in the Middle Estuary of the St. Lawrence River, Canada. These samples served as a time series for measuring chlorophyll a, photosynthetic capacity and many physical parameters. Sampling was conducted during the transition from neap to spring tides. Variations in chlorophyll a, both long and short-term, are coupled with the advection of water masses, which in turn depends on the tidal currents. The chlorophyll a concentration of the cells is also influenced by the vertical mixing, as it modifies the physiological state of the phytoplankton. Periodicities were also noted in the photosynthetic capacity, suggesting that the phytoplankton of this area have a homogeneous light history due to strong vertical mixing. The photosynthetic capacity is adapted to the mean light intensity in the mixed layer under these conditions. Semi-monthly variations of the mean light intensity in the mixed layer depend on the semi-monthly variations in the vertical mixing, whereas in the short-term, the variations in mean light intensity in the mixed layer are circadian. (Baker-FRC)
W82-04331

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 2H.
W82-04417

EVIDENCE FOR COEXISTENCE OF TWO DISTINCT FUNCTIONAL GROUPS OF SULFATE-REDUCING BACTERIA IN SALT MARSH SEDIMENT,

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Essex Univ., Colchester (England). Dept. of Biology.
I. M. Banat, E. B. Lindstrom, D. B. Nedwell, and M. T. Balba.
Applied and Environmental Microbiology, Vol 42, No 6, p 985-992, December, 1981. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Bacteria, *Sulfates, *Sediments, *Salt marshes, Sulfides, Sulfur bacteria, Molybdates, Fluoroacetates, Oxidation, Marine sediments, Marshes, Estuarine environment, Wetlands, Lake sediments, *England, Ray Creek, Colne Point Marsh, United Kingdom.

Two types of sulfate-reducing bacteria, one oxidizing acetate and one probably oxidizing hydrogen, were found in the salt marsh sediments of Ray Creek, Colne Point Marsh, United Kingdom. Acetate oxidation was partially inhibited by addition of fluoroacetate, a known inhibitor of acetate metabolism. Molybdate completely inhibited acetate oxidation. It apparently acts by suppressing adenosine triphosphate sulfurylase, common to both groups of bacteria. Acetate metabolism in freshwater pond sediments in the absence of sulfate was not affected by molybdate but was inhibited by fluoroacetate. Acetate was oxidized to carbon dioxide, not to methane. (Cassar-FRC)
W82-04464

DEPTH, SILT AND CURRENT: FACTORS IN THE TRANSVERSE MICRODISTRIBUTION OF THE BENTHOS IN THE FRESHWATER ESTUARY OF THE ST. LAWRENCE (PROFONDEUR, VASE ET COURANT, FACTEURS DE MICROREPARTITION TRANSVERSALE DU BENTHOS DANS L'ESTUAIRE D'EAU DOUCE DU SAINT-LAURENT (QUEBEC),
Quebec Univ., Trois-Rivieres. Dept. of Chemistry-Biologie.
B. Vincent.
Canadian Journal of Zoology, Vol 59, No 12, December, 1981. 3 Fig, 3 Tab, 29 Ref. English summary.

Descriptors: *Estuarine environment, *Species composition, *Benthic fauna, Silt, Flow velocity, *St Lawrence River, Water currents, Water depth, Rivers, Species diversity, *Spatial distribution.

To study the spatial variability of the faunal characteristics and numbers and relate them to the abiotic factors prevailing at various locations, benthic samples were collected with a Ponar bucket at 33 locations on a transect of the upper St. Lawrence estuary. Data were simultaneously obtained on the physicochemical characteristics of the water, water depth, silt content of the surface sediments, and current speed. The principal taxonomic groups represented were oligochaetes (34.4%), hirudinea (4.9%), gastropoda (38.1%), sphaeriidae (19.6%) and chironomids. The physico-chemical characteristics of the water were fairly stable. The most abundant species followed a definite zonation, but no species was truly typical of any one habitat. Depth, percentage of silt, and current velocity, in decreasing order, affected the structure of the benthic associations. The diversity was independent of these factors, but the organism density, number of taxa, and equitability were all significantly correlated with the percentage of silt. (Carroll-FRC)
W82-04472

EFFECT OF RIVER DISCHARGE ON THE DISTRIBUTION PATTERN OF DISSOLVED CONSTITUENTS IN THE GAMO ESTUARY, MIYAGI PREFECTURE,
Tohoku Univ., Sendai (Japan). Biological Inst.
E. Kikuchi, and Y. Kurihara.
Japanese Journal of Limnology, Vol 42, No 2, p 100-107, 1981. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater pollution, *Dissolved solids, *Phytoplankton, *Estuaries, *Gamo Estuary, Nanakita River, *Japan, Rivers, Nutrients, Nitrates, Chlorides, Phosphates, Ammonium, Dissolved oxygen, Oxygen, Eutrophication, Diatoms, Cytocella, Ciliates, Mesodinium, Salt wedge estuaries, Saline-freshwater interfaces, Sendai Bay.

Chlorinity, dissolved inorganic nitrogen, phosphate, and dissolved oxygen were measured at 7 sites in the Gamo estuary, Japan, a salt wedge estuary highly polluted with domestic sewage. A weir is located about 4.2 km upstream from the mouth. Sampling sites were located from the mouth to 4 km upstream and at different depths from the surface to the bottom, which ranged from 1 m deep at the mouth to 5 m deep in a trough. Ammonium and phosphate concentrations increased with distance upstream, and dissolved oxygen decreased with distance upstream. Levels of ammonium and phosphate increased with depth. Dissolved oxygen concentrations decreased with depth, reaching zero at the bottom of a trough. These results indicate that the deeper water was trapped in basins by shallow sills for long periods. Nitrate concentrations were higher in the fresh surface water than in the saline bottom water. The effect of the tide on the dissolved constituents was almost negligible in the estuary except near the mouth. In the brackish surface water dissolved oxygen levels were high, and ammonium, nitrate, and phosphate levels were very low. A phytoplankton bloom at low flow in summer was dominated by diatoms (Cytocella) in the fresh surface water and ciliates (Mesodinium) in the saline water. (Cassar-FRC)
W82-04543

SALINITY INTRUSION IN ESTUARIES,
Institute of Oceanographic Sciences, Merseyside (England).
D. Prandle.
Journal of Physical Oceanography, Vol 11, No 10, p 1311-1324, October, 1981. 7 Fig, 2 Tab, 30 Ref.

Descriptors: *Saline water intrusion, *Tidal effects, *Mixing, *Estuaries, Rivers, Model studies, Salinity, Fate of pollution, Dispersion coefficient.

One-dimensional solutions were examined for thd degree of saline water intrusion into estuaries of different shapes. These solutions emphasize the importance of the rate of change of cross-sectional area in determining salinity distribution. The salinity distribution was shown to be highly dependent on the dimensionless parameter VI, which equals U1 x X1 divided by D, where U1 = velocity of freshwater flow at position X1, the point where the salinity of the estuary equals the oceanic value, and D = longitudinal dispersion coefficient. The predicted and observed salinity distributions were compared for 8 estuaries. The values of D were within the range of 50-500 sq m per sec for 6 estuaries (Hudson, Potomac, Delaware, Bristol Channel, Thames, and St. Lawrence). Since salinity distribution is highly sensitive to the specified value of D, the one-dimensional, time-averaged approach may be limited. Attempts to derive a more rational dimensionless form for the longitudinal dispersion coefficient in terms of gross estuarine parameters were not successful. (Cassar-FRC)
W82-04574

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,
Thames Water Authority, London (England).
A. G. Cockburn, and R. J. Furley.
Water Science and Technology, Vol 13, No 11/12, p 693-698, 1981. 3 Fig, 5 Ref.

Descriptors: *Estuaries, *Water quality, Monitoring, Estuarine environment, Water management, Measuring instruments, *Thames River, Rivers, Water pollution control, Water management, England.

The paper discusses the reason for automatic continuous monitoring on tidal rivers and the requirements of such a system in the Thames Estuary. The Tidal Thames is a well mixed estuary stretching some 140 kilometers from Teddington, through the heart of London, th the North Sea. Prior to 1960 the Tideway was anaerobic and devoid of all fish life for much of its length, but improvements in effluent quality have resulted in minimum average dissolved oxygen concentrations of 30% in recent years and the consequent return of large fish populations. Automatic continuous water quality monitoring should prove an efficient and cost effective management tool in the continuing improvement of the Tidal Thames. Running costs including servicing requirements will be less than those currently incurred by manual sampling and analysis using launches, and the information obtained will be much more complete. Significant storm sewage discharges occur in the uppermost 30 kilometers of the estuary, where dilution is small; these can cause sudden severe depletion in dissolved oxygen and consequent fish mortality. It is possible to alleviate the situation by direct injection of pure oxygen into the river by barges towed to the appropriate locations. For this method to be viable, continuous monitoring, together with appropriate telemetry, is essential to give early warning of deteriorating water quality and proper operational control. Site selection for water quality monitoring programs is absolutely critical. (Baker-FRC)
W82-04591

A SUSPENDED SEDIMENT FRONT IN THE SEVERN ESTUARY,
Institute of Oceanographic Sciences, Taunton (England).
R. Kirby, and W. R. Parker.
Nature (London), Vol 295, No 5848, February, 1982. 5 Fig, 12 Ref.

Descriptors: *Estuaries, *Suspended sediments, Sediments, Salinity, Sedimentation, Estuarine environment, Topography, Coriolis force, Tidal effects, *Severn Estuary, *England.

The structure of the suspended solids field was observed in the Severn Estuary using a free-fall array consisting of two narrow-gap optical turbidity meters, a pressure depth sensor, and occasionally a continuously recording conductivity meter, allowing continuous and rapid vertical profiles to be made from drifting or anchored vessels. The regional spring surface and spring bed distributions show the sediment front as a zone of marked gradient approximately along the axis of the estuary between The Shoots and the Holm Islands, and extending across the inner Bristol Channel to the English coast in the region of Watchet, in Bridgewater Bay. The more turbid water mass lies on the English side of the estuary. On neap tides the regional distribution was similar, although the contrast between surface and bed concentration values is greater. Data plots showed that the sediment front was more prominent on spring than on neap tides and on ebb rather than flood tides. Steeply inclined concentration contours were noted across the gradient zone in the region between The Bridge and a line joining Barry and Burnham. The front may be due to an interaction between the regional and local topography. Coriolis effects and lateral phase differences in tidal elevation across the estuary, which set up secondary water circulation cells in the plane of the cross-section, leading to convergence along the main channel axis. It is concluded that the Severn estuary, while well mixed with regard to salt, shows marked lateral partitioning of suspended sediment, with a stably positioned front forming the junction between the two water masses. (Baker-FRC)
W82-04639

DISPERSION COEFFICIENTS IN ESTUARIES,
Birmingham Univ. (England).
For primary bibliographic entry see Field 5B.
W82-04684

SHEET FLOW IN A SALT-MARSH BASIN, NORTH INLET, SOUTH CAROLINA,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. L. Miller, and L. R. Gardner.
Estuaries, Vol 4, No 3, p 234-237, 1981. 4 Fig, 13 Ref.

Descriptors: *Laminar flow, *Salt marshes, Stratification, Tidal prism, Water storage, Estuaries, Estuarine environment, Tidal marshes, *South Carolina, North Inlet area, Saline-freshwater interfaces.

This paper evaluates the magnitude of sheet flow in a small marsh basin near North Inlet, South

Carolina by comparing basin storage curves determined by current measurements with a basin storage curve based on direct measurements of marsh topography and hypsometry. The basin is well outlined by terrestrial vegetation. The study indicated that on spring tides, more than 50% of the tidal prism that enters Oyster Landing basin enters as sheet flow over the grassy flats of the marsh. The discharge data also suggest that the storage curve for the basin may be a hystersis loop with separate flood and ebb segments. (Baker-FRC)
W82-04716

SEASONAL CHANGES IN THE DEPTH DISTRIBUTIONS OF INTERSTITIAL SALINITIES IN THE FRASER RIVER ESTUARY, BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Biology.
P. M. Chapman.
Estuaries, Vol 4, No 3, p 226-228, 1981. 2 Fig, 11 Ref.

Descriptors: *Sediments, *Interstitial water, *Salinity, *Fraser River estuary, Estuaries, *British Columbia, Estuarine environments, *Seasonal variation, Stratification.

Results of a study of vertical and temporal variations in the interstitial salinities of subtidal estuarine sediments are presented. The study was carried out at six stations in the Fraser River estuary spaced to encompass the whole spectrum from freshwater to salt water regions. Stations were sampled monthly in replicate at four sediment depths, and horizontal and vertical changes in interstitial salinity were recorded. The main pattern of flow in the Fraser River is a constant one of low discharge in winter, medium discharge in autumn, and highest discharge between May and June. Maximal salinities occur over winter and minimal salinities during freshet. The seasonal pattern of interstitial salinities at all stations reflected this trend. Interstitial salinities were conservative and reflected seasonal changes in the salinity of the overlying water. These seasonal changes in interstitial salinity are probably due to diffusion. Definite salinity gradients were present in the sediments, particularly in the mesohaline zone of the estuary, and the magnitude of these gradients changed seasonally. It is suggested that interstitial salinity gradients may be a common feature of estuaries. (Baker-FRC)
W82-04717

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

JEDDAH IV SEAWATER DESALINATION AND POWER PLANT IN OPERATION IN SAUDI ARABIA (MEERWASSERENTSALZUNGS UND KRAFTANLAGE JEDDAH IV IN SAUDI - ARABIEN IN BETRIEB),
G. Marotz.
Wasserwirtschaft, Vol 71, No 12, p 377-378, 1981. 1 Fig, 1 Ref. (No English summary).

Descriptors: *Desalination, *Distillation, *Powerplants, Jeddah, *Saudi Arabia, *Red Sea, Seawater, Boilers, Turbines, Water supply, Water treatment.

The Jeddah IV seawater desalination and power plant was put into operation in Saudi Arabia on October 24, 1981. This is currently the largest such plant in the world, and upon full operation will supply about 220,000 cu m of drinking water per day. It is located on the Red Sea, about 8 km north of the city of Jeddah. It covers an area of 20 hectares and supplies electrical energy as well as water. Five oil-fired boilers produce 605 t/hr of steam which is used to run the turbines and as the desalination starting product. The basic process for desalination is multi-stage flash distillation. Ten desalination sections can be operated independently, at a brine temperature of 112 C. Sulfuric acid is added to prevent the deposition of magnesium hydroxide and calcium carbonate in the evaporator-condenser chambers. The boiler supply and cooling water (43 cu m/sec at full capacity) is collected at 16 m below the sea surface, and prepurified with rakes and band filters. Oil is delivered by tank ship, with sufficient storage capacity on site for 32 days of operation. (Carroll-FRC)
W82-04581

DESIGN, FABRICATION AND START-UP OF A 25,000 GALLONS PER DAY ABSORPTION FREEZING VAPOR COMPRESSION DESALINATION PILOT PLANT.
Concentration Specialists, Inc., Andover, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220526, Price codes: A04 in paper copy, A01 in microfiche. Report, May, 1981. 63 p, 8 Fig, 1 Tab, 1 Append. 14-34-0001-8502.

Descriptors: *Desalination plant, *Freezing, *Vacuum, *Absorption, Pilot plant, Ice-brine systems, Refrigeration, Electric power demand, Specifications, *Wrightsville Beach, North Carolina, Test facility.

Concentration Specialists, Inc. designed, built, initiated start-up and began operational testing of a 25,000 gallons per day adsorption freezing vapor compression (AFVC) sea water desalination plant at the Office of Water Research and Technology's Test Facility at Wrightsville Beach, North Carolina. The AFVC process is a novel freezing process based upon an absorption cycle powered by a heat pump. The energy savings and lack of corrosion of freezing compared to evaporative processes is a significant feature of this process. The pilot plant was designed to produce 25,000 gallons per day of fresh water while consuming 49 kWh of energy per 1000 gallons of product water. Upon design and fabrication, start-up and operational testing of the pilot plant has shown the need for considerable process and component modification as would be expected with a developmental process. By the end of the contract period, June 1980, the pilot plant produced 8000 gallons per day of product water under non-steady state operating conditions. Equipment modification continues toward increasing plant capacity and achieving steady state production.
W82-04724

3B. Water Yield Improvement

WILL NEW ORLEANS MISS THE MISSISSIPPI,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-04274

3C. Use Of Water Of Impaired Quality

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,
R. J. Franco, J. C. Wykowski, and J. Delaunay.
Industrial Water Engineering, Vol 18, No 5, p 14-19, September-October, 1981. 3 Fig, 8 Tab, 1 Ref.

Descriptors: *Water reuse, *Cooling water, *Industrial wastewater, Impaired water use, Water treatment, Wastewater treatment, Water softening, *Fos Refinery, *France, Heat transfer, Corrosion control, Filtration, Ammonia, Pilot plants, Biological treatment, Chromates, *Oil refineries, Biocides, Bacteria, Scaling.

Pilot plant studies at the France, demonstrated that ammonia-containing refinery wastewater effluents could be successfully used in cooling towers with addition of chromate corrosion inhibitors and appropirate water treatment. The effluent contained 20-50 mg per liter ammonia, which encouraged biological fouling. This was controlled by shock chlorination, supplementary biocides, and the chromate inhibitor (zinc chromate phosphate). Isothiazolin was effective in depressing bacterial counts, but the other antibacterials tested (methylene bisthiocyanate, sulfone, and acrolein) permitted rapid regrowth of bacteria. Scaling was minimized by softening the water to reduce total hardness from 340 to 87 mg per liter as CaCO3. Suspended solids should be less than 10 mg per liter. Filtration and an alternate water supply must be available in case of wastewater treatment upsets. Non-chromate inhibitors (two polyphosphate-phosphonates and zinc polyolester) did not adequately protect the system against corrosion and loss of heat transfer. They allowed growth of sulfate-reducing bacteria. Use of the effluent in cooling towers will result in significant reductions of water use, water discharge, and contaminant discharge. (Cassar-FRC)
W82-04317

REFUSE OF POWER PLANT COOLING WATER FOR IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, H. J. Vaux Jr., and L. H. Stolzy.
Water Resources Bulletin, Vol 16, No 5, 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Powerplants, *Groundwater management, *Water reuse, *Cooling water, *Irrigation practices, California, Water policy, Saline water, Water quality management, Hydroelectric plants, Environmental protection, Evaporation, Impaired water use.

California water policy at present requires saline blowdown waters from powerplants to be disposed of in sealed evaporation ponds to prevent deterioration of groundwater. This policy attempts to strike a balance between demand for energy and environmental protection goals. Saline blowdown waters may be used in the irrigation of certain salt tolerant crops. When the irrigation is managed carefully, residual salts may be stored in the soil profile with litter potential for harming groundwater. Studies of blowdown irrigation water discharge below a successful irrigation project indicated a downward movement of salts below the root zone, but no farther than with conventional blowdown water disposal techniques. The reuse of blowdown waters for irrigation proved less costly than storage in evaporation ponds. These analyses showed that irrigation reuse of blowdown water is a viable means of saline water disposal within the existing standards of groundwater quality protection. (Geiger-FRC)
W82-04445

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James), Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5D.
W82-04566

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,
Colorado E Agricultural Experiment Station, Fort Collins.
For primary bibliographic entry see Field 5E.
W82-04705

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
W. R. Haag.
PhD Thesis, June, 1981. 165 p, 24 Fig, 5 Tab, 119 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23155.

Descriptors: *Model studies, *Chlorination, *Saline water, *Chemical reactions, Industrial water, Cooling water, Powerplants, Environmental effects, Bromine.

A review of the present state of knowledge of natural water chlorination chemistry was performed, with particular reference to saline waters.

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Experimental work demonstrated that bromochloramines can readily form under conditions of power plant cooling water chlorination, if saline water is used. Further experimental work explained the results of previous workers by showing that chlorine losses at very high doses in seawater are simply the result of chlorate and bromate formation which is negligible at normal doses. The most important chlorine-produced oxidants, along with the relevant chemical reactions, were chosen as a basis for a kinetic model of saline water chlorination chemistry. Kinetic data were compiled in a computer program which simultaneously solves 24 differential equations, one for each species modelled. Estimates were made for the unknown rate constants, with the hope that measured values would be determined by future researchers. A purely predictive model was not possible due to the great variability in the organic demand; however, the model is applicable under a broad variety of conditions (except sunlight), and its provides a reasonably good description of a halamine chemistry under environmental conditions. (Sinha-OEIS)
W82-04729

3D. Conservation In Domestic and Municipal Use

CONSERVING WATER THROUGH PRICING,
State Univ. of New York at Albany.
E. F. Renshaw.
Journal of the American Water Works Association, Vol 74, No 1, p 2-5, January, 1982. 4 Fig, 11 Ref.

Descriptors: *Water conservation, *Water shortage, *Pricing, Water demand, Water use, Economic aspects, Social aspects, Domestic water.

The success of water conservation efforts and availability of new technologies for reducing water consumption in households and industries suggest that conservation opportunities should be explored before projects to augment water supply are initiated. Classical economic theory illustrates the benefits of pricing water at the long-run marginal cost rather than the long-run average cost. The regressive nature of such a pricing policy could be combated by giving lump sum credits to deserving households or businesses, independent of actual water use. Lifeline rates and progressive rate structures have considerable appeal, but are neither an efficient way to ration water nor an equitable way to redistribute income. To maximize social benefits from water it is necessary to minimize social costs, which consist of cost to the utility of supplying water and the loss of consumer surplus that is likely to result from a water shortage. While nonprice rationing has achieved a high degree of social acceptance in communities that have experienced a water shortage, it will usually result in a larger economic loss than would be the case if wate were rationed by means of a higher price. A temporary system of penalty rates for excessive use and conservation credits would encourage more rational allocation of available water during shortages. Such systems appear to be acceptable by the public. (Carroll-FRC)
W82-04272

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,
Oklahoma State Univ. Stillwater. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W82-04343

LEAK DETECTION--HISTORIES,
Alvord, Burdick and Howson, Chicago, IL.
J. E. Pilzer.
Journal of the American Water Works Association, Vol 73, No 11, p 565-567, November, 1981.

Descriptors: *Leakage, *Water distribution, Water conservation, *Water loss, *Water supply systems, Municipal water.

Several case histories of leak detection in water systems are reported from a survey of water companies and consultants by the American Water Works Association leak detection committee. In most cases discovery of leaks, some very large and some multiple small leaks, saved considerable water and money. A practical leak detection program can start with a modest overall study to determine where pinpoint leak detection would be most productive. Review of records can identify areas for closer scrutiny. The leak survey may be performed by water company personnel or an outside consultant. It is important to use the proper detection equipment, which filters some of the background noise that makes detection difficult. As energy and chemical costs escalate, leak detection should be considered even in systems with relatively low losses. (Cassar-FRC)
W82-04363

LEAK DETECTION PROGRAMS RECOVER REVENUES,
Community Consultants, Inc., Provo, UT.
S. E. Sowby.
Journal of the American Water Works Association, Vol 73, No 11, p 562-564, November, 1981. 2 Fig.

Descriptors: *Leakage, *Water metering, *Water distribution, Water conservation, *Operating costs, Water loss, Municipal water, Benefits, Case histories.

Seven case histories of leak detection in towns located in the semiarid western U.S. are given. In the first case, an average daily use of 1500 gal per person indicated that losses were occurring. Investigations showed that 33% of the raw water supply was leaking into a stream, and another 17% was being lost from the distribution system. In case 2, an old lead joint pipe had 21 leaks, which lost 50% of a town's water supply during a drought. In the third case, metering located a crushed pipeline leaking 4 mgd or 20% of a Utah city's supply into a river. Repair of 23 large meters in the fourth example increased an Idaho city's water revenue by $100,000 per year at a cost of $5000 in repairs. In a Colorado city, the fifth example, 55% of meters were broken or inaccurate, not accounting for 18-43% of the water metered into the system. In case 6, metering an entire city reduced waste by 30%, and leak detection located 32 leaks. In the last case, malfunctions and leaky valves were causing losses. (Cassar-FRC)
W82-04375

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
W. J. Maier, J. DeZellar, and R. M. Miller.
Water Resources Bulletin, Vol 17 No 4, p 672-677, 1981. 2 Fig, 8 Tab, 12 Ref. OWRT B-139-MINN. 14-34-0001-8092.

Descriptors: *Water use, *Water conservation, Wastewater treatment, *Water treatment facilities, Water demand, Drought, Pollution load, Costs.

Experiences during the 1976-77 drought in California indicated that substantial savings in water consumption can be achieved under emergency conditions, resulting in some problems in wastewater treatment plants. In contrast, planned water conservation can be engineered to provide maximum monetary benefits when conservation programs coincide with increased populations to be saved. Fortunately, the self-cleaning hydraulic characteristics of circular channels, such as sewers, are relatively insensitive to flow over a wide range, reducing the problems caused by increased residence time. A computerized model study of effects of effluent flow reduction in a conventional municipal wastewater treatment plant indicated that the total BOD load discharged to receiving waters to reduced in direct proportion tothe flow reduction. The higher influent concentrations were compensated by increased residence time in the plant. The effects on suspended solids are similar. Treatment plant operating costs are relatively insensitive to hydraulic loading, resulting in an increase per unit volume of sewage treated. The net effect, however, is a decrease in per capita customer charges. (Baker-FRC)
W82-04557

REDUCING THE FLUSH,
Building Research Establishment, Watford (England).
C. J. D. Webster, and P. J. Davidson.
Water, No 42, p 12-16, 1981. 5 Fig, 3 Ref.

Descriptors: *Flushing, *Water conservation, Domestic water, Domestic wastes, *Toilets, Wastewater, Design criteria, Great Britain.

Efforts are underway to reduce the amount of water used in dwellings and elsewhere for domestic purposes. The flushing of water closets (WCs) is estimated to account for up to 20% of the total public water supply although complexities may be involved in obtaining optimum savings from this area. Current pans used in the United Kingdom are designed to operate on a 9 liter flush, as there has been little incentive until now to design for a lower volume. In the absence of immediately available WCs using reduced flush volumes, the use of dual flush systems is an immediate strategy which both follows the normal replacement approach and depends on the user's mode of operation for its saving. The dual flush principle has been available for a long time, giving the user the option of about 4-5 liters or the full 9 liters. All trials have reported substantial water savings. Controlled flush cisterns are arranged so that flushing terminates as soon as the handle is released. In dwellings where there is a metered water supply there is some financial incentive to the householders to install a new system. It is thought to be possible to design a suite that will perform acceptably at three liters or a little more, and that such suites can be used in most drainage installations, subject to certain restrictions. Changes in urinal structure are also discussed. (Baker-FRC)
W82-04654

THE TRADITIONAL APPROACH TO WATER LOSS,
Thames Water Authority (England).
J. S. Pocock.
Water, No 42, p 43-44, 1982.

Descriptors: *Water loss, *Water supply development, Water demand, Water management, *Pipelines, Leakage, *Water conservation, Design standards.

At intervals of about every 30 years an apparent interest in water losses has surfaced. The need for better materials and better standards of design was recognized at a very early stage. Detailed regulations regarding the customers' fittings and pipework were introduced in 1871. Recently the institution of consumer protection policies has done away with the threat of retribution wherein water supplies could be shut off in cases of uncontrolled water waste in London. One of the earliest means of assessing the effectiveness of a system of waste control was that of comparing the total consumption in different towns on a per capita basis. A remarkable correlation was found between the demand growth rates of four British towns, and it was concluded that at any time within that period an effective waste control policy would have had a significant impact on the capital program of the organization. The financial return derived from an increase of effort in waste control can vary widely from place to place in an authority's area, perhaps by a factor of as much as 20. (Baker-FRC)
W82-04656

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
R. D. Hansen.
PhD Thesis, 1981. 102 p, 14 Fig, 18 Tab, 32 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-20713.

Descriptors: *Water use, *Multivariate analysis, *Municipal water, *Model studies, Water supply, Drought, Groundwater, Surface water, *Utah.

This work formulates two multivariate models for the study of municipal water systems: (1) a monthly time series model for use in analyzing water use and (2) an additive logit model for analyzing water system response to drought. Both models are applied to Utah data. The time series regression model is used to study water demands in the Salt Lake City Water Department (SLCWD), Ogden City, and Granger-Hunter Improvement District service areas. The research shows that real price, as well as three weather/climate variables--average temperature, total precipitation, and daylight hours (percent)--has a significant impact on water usage in Utah. The usefulness of a monthly time series model for examining water management options is demonstrated. A hypothetical peak-season pricing scheme is examined. The characteristics of municipal systems which restricted water usage during the 1976-77 drought are studied using a logit model. This model specifies that the natural logarithm of the odds in favor of a municipal system having restrictions is a function of the size of the system, the percentage of individual connections served by separate outdoor systems, and the variability of the water supply. It is found that systems which rely heavily on surface water supplies were more vulnerable to drought conditions that those using groundwater or a combination of sources. The larger systems had a higher propensity for using restriction during the drought, as did those systems without separate pressure irrigation. (Sinha-OEIS)
W82-04728

3E. Conservation In Industry

STATUS AND PROBLEMS OF PROCESS WATER SUPPLY IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY (SITUATION UND AUFGABEN DER BETRIEBSWASSERWIRTSCHAFT IN DER OBST- UND GEMUSEVERARBEITENDEN INDUSTRIE),
M. Henkel, and M. Richter.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 358-359, 1981. 3 Fig, 2 Tab. (No English summary).

Descriptors: *Industrial water, *Food processing industry, *Water management, Water reuse, Fruit crops, Vegetable crops, Process water, Water conservation, Effluents, Wastewater discharge, Economic aspects, Social aspects, Water use.

A survey of 56 representative fruit and vegetable processing plants in the German Democratic Republic revealed that the status of water management in these industries is generally unsatisfactory. Considerable differences in quantities of water consumed per unit finished product were found even within the individual branches (product groups) of fruit juice, canned products, frozen products, fresh products, jams and jellies, and baby foods. Water supply becomes especially problematic for these firms when dry periods coincide with the start of the busy season. Only about half of the plants queried had information on their wastewater discharges, and most of these determined only degradable/filterable substances and pH. Of the approximately 50% of the plants surveyed which discharged their wastewaters directly into receiving streams, only 46% had even mechanical treatment plants, and 39% had to pay discharge fees. The responsibility of plant managers for water management is clearly outlined in East German law. Suggestions for improving the currently unsatisfactory situation included metering, increasing the consciousness of employees regarding water conservation, inclusion of water specialists in plant planning, and increasing research programs for specific industries. A few instances of successful water conservation projects are listed, including addition of condensate from fruit juice concentration to the transport water, recycling water from autoclaves and pasteurizers, recycling raw fruit wash water, and other in-plant reuse. (Carroll-FRC)
W82-04584

3F. Conservation In Agriculture

A CONCEPTUAL FRAMEWORK FOR EVALUATING AGRICULTURAL WATER CONSERVATION POTENTIALS,
California Univ. Davis. Dept. of Land, Air, and Water Resources.
D. C. Davenport, and R. M. Hagan.
Water Resources Bulletin, Vol 16, No 4, p 717-723, August, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Water losses, *Agricultural, *Evapotranspiration, *Water conservation, Methodology, Irrigation efficiency, Runoff, Subsurface runoff, Evaporation, Water reuse, Water quality, Water management, Water use efficiency, Seepage control.

Types of water losses in agriculture are defined and potential conservation measures outlined. Recoverable water remains on or below the land surface and includes seepage, leakage, spills, surface runoff and percolation below the root zone. Water is irrecoverably lost by evaporation from soil or water bodies and by transpiration from plants. The largest potential for water conservation is in reducing irrecoverable losses. Possible methods include reducing the ratio of open water surface to total volume in ponds and reservoirs, using groundwater storage via recharge ponds, applying evaporation supressants to surfaces of water bodies, irrigating at night, using drip irrigation and mulches, growing shorter season crops or varieties, reducing the cropped area and the acreage of phreatophytes, using deficit irrigation, withholding water at nonsensitive growth stages, applying foliar antitranspirants, adjusting planting dates to avoid high evapotranspiration periods, changing row direction and plant spacing to alter solar and advected energy, and controlling weeds. Recoverable water losses may be managed by recovery and reuse of water, reducing further losses, and intercepting water before it reaches the sea and becomes unusable. Advantages and disadvantages of reducing recoverable and irrecoverable losses by these methods are discussed. (Cassar-FRC)
W82-04251

IRRIGATION PRACTICES FOR RECLAIMED ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India). Div. of Engineering.
V. V. D. Narayana, and N. K. Tyagi.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 400-406, December, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Irrigation efficiency, *Border irrigation, *Crop production, *Alkaline soils, Irrigation practices, Contour irrigation, Crop yield, Rice, Wheat, Mathematical studies, Slopes, Grading, *India.

Field experiments were carried out in India to compare irrigation efficiency on graded and level borders, determine the stream cutoff point, and determine the optimum border dimensions and see how sloping borders could be adopted for rice or wheat cultivation on alkali soils. With the prevailing gentle land slope of 0.1-0.2% as the border grade, wheat and rice can be grown in a layout of graded and closed borders in rotation. Light and frequent irrigations may be applied by cutting off irrigation once it has advanced to 70% of the border length. Irrigation efficiencies in small fields which are common in the Indo-Gangetic alluvial plains may be enhanced by using graded borders with lengths ranging from 50 to 70 m and widths from 6 to 8 m. These graded borders may also be used for growing rice during the rainy season by dividing them into two or three compartments connected by asbestos pipes. The rice yield estimates for a sloping border layout in two or three compartments are 65.4 and 67.7 quintals/ha, respectively. (Geiger-FRC)
W82-04269

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W82-04287

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
T. Strelkoff, and A. J. Clemmens.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 361-382, December, 1981. 18 Fig, 6 Ref.

Descriptors: *Mathematical studies, *Infiltration, *Mathematical models, *Border irrigation, Irrigation, Stream banks, Graphical methods, Streambeds, Rrunoff, Model studies, Recession curve.

A simple case of general stream border advance contains a plane border of great length and a constant inflowing discharge prior to cutoff. The advance curve is controlled by border slope, roughness, infiltration, and inflow discharge and cutoff time. If the advanced function is viewed in dimensionless terms, the number of controlling parameters is significantly reduced. If only advance prior to inflow cutoff is of interest, then two dimensionless parameters govern the dimensionless advance curves. Methods of applying kinematic-wave theory to the computation of border-irrigation flow proved simpler than the zero-inertia analysis employed for the general case. Using a dimensionless boundary value as a pertinent controlling variable increased the number of dimensionless governing parameters to three. Difficulty in representing a three-parameter family of advance curves was overcome by using normal depth as the characteristic depth and equating the dimensionless parameter for bed slope to one. Curves were given representing all practical cases of advance of an irrigation stream over a plane border with inflow that is constant prior to cutoff. (Geiger-FRC)
W82-04308

SUBSURFACE TRICKLE IRRIGATION MANGEMENT WITH MULTIPLE CROPPING,
Department of Agriculture, Phoenix, Arizona, Water Conservation Laboratory.
D. A. Bucks, L. J. Erie, O. F. French, F. S. Nakayama, and W. D. Pew.
Transactions of the ASAE, Vol 24, No 6, p 1482-1489, November/December, 1981. 6 Fig, 5 Tab, 17 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Evapotranspiration, *Trickle irrigation, Subsurface irrigation, Surface irrigation, Cultivation, Cantaloupes, Onions, Carrots, Productivity, Planting management, Soil-water-plant relationships.

Subsurface trickle irrigation with multiple cropping and minimum cultivation had many advantages over surface trickle irrigation: minimal interference with field operations, continuous production of two or more row crops without replacement of trickle lines, and extension of the useful life of a trickle system over a larger production base. Spring and Fall cantaloupes were grown on a clay loam soil with moderately saline water in 1977, 1978; dry onion and carrots in spring 1979; and fall cantaloupe in 1979. Cantaloupe yield was higher with weekly than with daily trickle irrigation; onion yield was higher with daily irrigation. Carrot yields were not affected by irrigation frequency. Production was highest at water application rates equal to or slightly higher than the seasonal evapotranspiration values for furrow irrigation. Maximum cantaloupe production was obtained with an average evapotranspiration of 51 cm for the spring crop and 39 for the fall crop. Seasonal evapotranspiration values for trickle irrigated onions and carrots were 56 cm and 41 cm, respectively. Roots of these plants did not clog the subsurface irrigation lines. (Cassar-FRC)
W82-04356

LIBRARY U. OF I. - URBANA CHAMPAIGN

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,
California Univ., Davis.
R. M. Hagan, and E. B. Roberts.
Transactions of the ASAE, Vol 24, No 6, p 1539-1545, November/December, 1981. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Energy, *Cost analysis, *Irrigation efficiency, Water requirements, Irrigation design, Management, Surface irrigation, Sprinkler irrigation, Furrow irrigation, Electric power, Pumping, Peak demand, Water costs.

Energy, water, and cost tradeoffs were examined in detail for 28 variations of irrigation system design and operation. These included sprinkler irrigation (hand-move, wheel-line, four types of center-pivot, and two types of lateral-move) and furrow irrigation (four types of graded and two types of level). The assumed crop was cotton growing in the San Joaquin Valley on very fine sandy loam soil. Both inexpensive, low energy water and expensive, high energy water were considered. Changes made to conserve water either increased or decreased annual energy requirements and annual costs. No single system provided the lowest energy requirements, water requirements, and costs. A guide is given to determine the feasibility of shifting irrigation pumping away from peak electrical use hours. It considers the water supply capacity, irrigation system capacity, and other factors such as labor and capital costs. Suggestions are given for modifying systems if changes are feasible. (Cassar-FRC)
W82-04360

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W82-04361

DEEP TILLAGE OF IRRIGATED PULLMAN CLAY LOAM--A LONG-TERM EVALUATION,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 2G.
W82-04372

SOIL AND WATER REGIMES FOR OPTIMUM AND FOR MAXIMUM YIELDS,
South Dakota State Univ., Brookings. Water Resources Inst.
L. O. Fine, and J. D. McLeod.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211483, Price codes: A03 in paper copy, A01 in microfiche. Completion Report December, 1981. 32 p, 17 Fig, 6 Tab, 4 Ref. OWRT A-068-SDAK. 14-4-0001-8044.

Descriptors: *Water use efficiency, Soybeans, *Irrigation efficiency, *Crop production, *Soil-water-plant relationships, *Cost-benefit analysis, Corn, Sorghum, *Great Plains.

Rapidly increasing demands on usable water resources, and escalating energy costs, with virtually stable or falling farm commodity prices have resulted in production pressures and cost-price squeeze situations for agriculture, particularly irrigated agriculture, in the corn-soybean-sorghum areas of the Great Plains. Actual out-of-pocket pmping costs have doubled or tripled in 4-6 years in most areas, and are projected to double again in the next 8-10 years. These circumstances are especially important to the irrigator with high lifts or in an area of especially high energy costs. The situation described makes it essential that the irrigator know, for each crop, the time of most critical water need by that crop, the amount to supply, and the nature of the water supply-yield response curve, so that he can manage his water supply to the best advantage. If two or more crops need water simultaneously and his water supply or funds available are limited, he needs to make a decision as to which crop to water and suffer the least economic loss. For more than three decades, information has been available on the consumptive use: total, seasonal distribution of need and critical periods of need of water by corn. The results of most investigations in the northern Great Plains point to a peak period of maximum daily use corresponding with the grand period of growth through tasseling-silking. Some studies agree on the critical nature of the tassel-silk brown stage for maximum yield impact. Because of the above quite well established information for corn, it was felt that a more productive study area would be the water regimes most profitable and productive for soybeans.
W82-04415

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Transactions of the ASAE, Vol 24, No 6, p 1553-1561, November/December, 1981. 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Irrigation design, *Drain spacing, *Subsurface irrigation, *Soil water movement, Design criteria, *Drainage systems, Soil properties, Water table fluctuations, Model studies.

Design of subirrigation and drainage systems depends on soil properties, crop, and climate. Movement in these systems is lateral from a drain or open ditch (saturated flow) and vertical in the zone above the water table (unsaturated flow). Three operational modes are considered in design of a subirrigation system. (1) Steady state--the drains should be spaced to maintain the desired water table depth range during long periods of high evapotranspiration. (2) Transient state--the system should be designed to manipulate the water table as desired in case of operator error, equipment failure, or low levels at the beginning of the growing season. (3) Subirrigation under changing weather conditions--the operation of the system in both deficient and excessive rainfall periods should be considered. Methods are given for calculating the position and shape of the water table during steady state and transient subirrigation. Use of the water management model, DRAINMOD, for operation of a subirrigation system under changing weather conditions is discussed. A drainage system is developed for a 110 acre field of sandy loam underlain by sandy clay loam near Farmville, North Carolina. Optimum drainage spacing is 18 m for subirrigation-drainage and 25 m for conventional drainage alone. (Cassar-FRC)
W82-04538

WATER USE EFFICIENCY AND ROTATIONAL WATER SUPPLY AT THE FARM LEVEL: CERTAIN RESULTS FROM AN EXPERIMENTAL PILOT PROJECT IN GUJARAT STATE, INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
T. K. Jayaraman.
Water Supply and Management, Vol 5, No 6, p 391-399, 1981. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Irrigation efficiency, *Water use efficiency, Rotational irrigation, Irrigation practices, *India, Agriculture, Water management, Social aspects, Economic aspects, Vegetable crops.

Pilot studies (1976-1980) in the 557 ha Mahi-Kadana project, India, showed that rotational irrigation in the rabi season increased water use efficiency to 69% the season the method was introduced and 72% after the system was stabilized. Water use efficiency in the 2 years before rotational irrigation were 41% and 59%. The total number of rrigated acres increased 9% after rotational irrigation. Cropping intensity also increased from 57-78% during the control years to 85% under rotational irrigation. The total water drawn from November to March averaged 532.70 and 569.76 cusecs in the control years and 530.76 and 509.19 cusecs in the rotational irrigation years. A survey of farmers after the project was completed showed that owners of both large- and small-size holdings supported the program. Quarreling over water supplies and worry about receiving water on time had been eliminated. (Cassar-FRC)
W82-04608

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 2G.
W82-04671

ENERGY AND WATER CONSERVATION STRATEGIES IN IRRIGATED AGRICULTURE,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. L. Ritschard, and K. Tsao.
Water Resources Bulletin, Bulletin, Vol 16, No 2, p 340-347, April, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Water conservation, *Drought, *California, *Irrigation practices, Irrigation, Farming, Water supply, Water management, Energy, Energy conservation.

Conservation strategies applicable to California are considered in the light of the drought of 1976 and 1977. These strategies include increased use of ground water, increased irrigation efficiencies, and shifts in cropping patterns. These modifications lessened the losses due to the drought. However, some of these changes may have caused problems for future water supply, for example the extensive pumping of ground water supplies and ground subsidence. Changes in irrigation practices may have affected the salt balance for future years. Maintaining and augmenting surface water supply, increasing power use efficiencies, and improving irrigation efficiencies are viewed as potential conservation strategies for that region. Electricity savings associated with water conservation have been estimated to be as much as 25%. Specific near term actions suggested for facilitating conservation include an expanded irrigation management system, efficient water deliveries, and a continued effort on the part of individual growers to use resources during periods of normal rainfall as they were used under drought conditions. (Baker-FRC)
W82-04736

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
For primary bibliographic entry see Field 2A.
W82-04267

SIMPLE EQUATIONS FOR HOOGHOUDT EQUIVALENT DEPTH,
Democritos Univ. of Thraki, Xanthi (Greece). School of Engineering.
J. G. Sakkas, and V. Z. Antonopoulos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 411-414, December, 1981. 1 Tab, 4 Ref.

Descriptors: *Hydrologic models, *Design criteria, *Tile drainage, *Mathematical equations, Mathematical studies, Drainage, Drain spacing, Drainage practices, Drainage engineering, Drains, Mathematical models.

The Hooghoudt equation for drainage design problems has been reworked and simplified by other researchers to include dimensionless variables. Unique nomographic solutions for the equivalent depth and drain spacing formulas may be used in conjunction with elaborate computer prorams to solve transient flow problems. For faster estima-

tions of the equivalent depth which avoid storage of a table in the computer memory, approximate fomulas have been developed which may be reworked into simple algebraic expressions. A series of values for the drain spacing function was used to fit three curves to the data by the least squares method. The relative error using these solutions was dependent upon the radius of the tile drains. The simplified formulas show no appreciable loss of accuracy and may be used to compute the equivalent depth for steady or unsteady state drainage problems with a desk calculator or digital computer. (Geiger-FRC)
W82-04271

WILL NEW ORLEANS MISS THE MISSISSIPPI,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. G. Kazmann.
Journal of the American Water Works Association, Vol 73, No 11, p 18, 20, November, 1981. 1 Fig.

Descriptors: *Saline water intrusion, *Disasters, *Water supply development, *New Orleans, Louisiana, *Mississippi River, *Atchafalaya River, Municipal water, Rivers, Flood damage, Flood control, Old River Control Complex, Conjunctive use, Water resources development, Water management, Injection wells, Alternative planning, Potential water supply, Water control.

Cities with water supplies vulnerable to natural disasters should plan alternate means of obtaining water. New Orleans faces the possibility of losing Mississippi River flow to an alternate distributary, the Atchafalaya River. Throughout the early 20th century an increasing proportion of river flow entered the Atchafalaya, reaching greater than 30% by 1954. The Old River Control Complex was built at the point where the Atchafalaya and the main stem are closest, near Simmesport. This structure consists of a spillway and an overland structure to assist during floods. The Atchafalaya channel continued to deepen and build a higher flood plain in the lower basin. The 1973 flood greatly weakened the control structure. If this is destroyed by a future flood, 70% of the river flow would be diverted through the Atchafalaya. Although navigation in the New Orleans area would not be affected, the Mississippi River water could become saline, unusable for drinking or industrial purposes. A proposed scheme to provide water to the city under these circumstances is conjunctive use of groundwater and water from the Pearl River. A treatment plant would inject filtered surplus river water into a well field, prventing land subsidence from excess groundwater withdrawals. Although the Corps of Engineers claims that the Mississippi River can be kept in its present course indefinitely, the author suggests that an alternate supply must be established for New Orleans before a catastrophe occurs. (Cassar-FRC)
W82-04274

DETENTION BASINS--AN URBAN EXPERIENCE,
Georgia Inst. of Tech., Atlanta.
T. N. Debo, and H. Ruby.
Public Works, Vol 113, No 1, p 42-43, 93-94, January, 1982.

Descriptors: *Flood control, *Detention reservoirs, *Urban drainage, Maintenance, Safety, Retention basins, Basins, *Atlanta, Georgia, Runoff, Evaluation.

Detention basins, encouraged for runoff control in the Atlanta, Georgia, metropolitan area, also produce problems. These include maintenance problems and health and safety problems. Detention basins do not effectively control flooding in all situations. Sometimes all the drainage is concentrated in one drainage channel. The combined effects of several detention basins may change the timing of flood discharges so that higher peak flows will occur than would have occurred under natural conditions. The many swimming pool-sized detention basins have little effect on downstream flooding. Erosion may also be increased. Detention basins designed for a 100-year flood have little flood control effect on a 5- or 10-year storm. Costs assessments of detention basins should consider loss of valuable land for building, esthetics, and loss of tax revenue. A survey of residents living near 15 small detention basins showed that 68% said no water accumulated in the basins, 12% felt the basins decreased flooding problems, and 5% felt drainage problems were aggravated. Over 70% did not realize that adjacent property owners were responsible for maintenance. A survey of engineers indicated that many basins were not functioning as planned and that only basins in developments of 20 acres or more had a major positive flood control effect. (Cassar-FRC)
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,
Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
For primary bibliographic entry see Field 2E.
W82-04334

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,
For primary bibliographic entry see Field 8A.
W82-04364

ANALYSIS OF DETENTION BASIN SYSTEMS,
Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 2A.
W82-04444

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),
Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
For primary bibliographic entry see Field 2A.
W82-04459

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),
Technische Univ., Dresden (German D.R.).
S. Dyck.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 331-335, 1981. 9 Fig, 10 Ref. (No English Summary).

Descriptors: *Reservoirs, *Water storage, *Planning, Design criteria, Management planning, *Reservoir operation, Flow control, Reservoir releases, Water demand.

Storage reservoirs, as important components of water management systems, must be carefully designed and operated. The general flow equalization goal of storage reservoirs, either in terms of constant release throughout the year or of demand-based release, must be achieved with the smallest possible storage volume. The most important factors influencing the selection of storage volume are the distribution function of the inflow (coefficient of variation and skewness), the determination interval, the long-term and short-term persistence characteristics of the inflow series, the demand or release function, the operation or balancing time, the initial level of the reservoir, and the simulation model of the experimental method. The simple autoregression model or Markov model is generally superior to the fractional noise model. For annual determination intervals, series of at least 1000 data runs are required in order to assure 99% reliability of coverage of the demand with the selected storage volume. Optimal reservoir operating plans, in terms of maximal compensation of the flow variations, were developed using the 'rule of clamped thread', i.e., a process for calculating the shortest path through a corridor of irregular shape. the inherent unpredictability of future inflows emphasizes the great significance of large data series, especially in the case of smaller reservoirs. (Carroll-FRC)
W82-04576

MONEY DOWN THE DRAIN,
Hydraulics Research Station, Wallingford (England).
P. Colyer.
Water, No 42, p 6-9, 1982. 2 Fig.

Descriptors: *Urban drainage, *Economic aspects, Computers, Automation, *Design criteria, Management, Construction, Water management, Drainage, Storm drains, *Urban runoff.

Due to the great expense involved in urban drainage networks, it is imperative that the system be efficient, well founded and accurate regarding design, construction and management. The Wallingford Procedure is a set of computer programs and accompanying reports which embody the latest recommendations on urban storm drainage. It is based on research started in 1974 at the Hydraulics Research Station, the Institute of Hydrology and the Meteorological Office. The Procedure presented four alternative methods. One is appropriate for design work only, one for analysis only and two for both design and analysis. The Modified Rational method is based on the long-established principles of the Rational method, calculating peak runoff discharge only. The Optimising method determines flows from the Modified Rational method but a minimum cost design is produced. The Hydrograph method includes the full modelling procedure for surface runoff and free surface pipe or channel flow. The simulation method includes all the main features of the Hydrograph method and also extends to surcharge analysis and surface flooding. Flapped outfalls can also be represented. The computer package is available from the Hydraulics Research Station. (Baker-FRC)
W82-04653

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2A.
W82-04721

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-04725

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 6A.
W82-04737

4B. Groundwater Management

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,
Oregon State Univ., Corvallis.
T. S. Vinson, and L. Mahar.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 343-359, December, 1981. 14 Fig, 3 Tab, 31 Ref.

Descriptors: *Groundwater movement, *Groundwater management, *Moisture probe, Spray irrigation, Percolation, Moisture meters, Moisture profiles, Soil columns, Moisture content, Irrigation water.

Studies were conducted to assess the feasibility of using subsurface neutron moisture probes to estimate soil percolation rates as part of a long-term research project to determine hydrologic conditions at a spray irrigation facility. The new technique utilizes the soil moisture content in relation

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to time obtained at two levels in a soil column or profile in which one-dimensional percolation is taking place. The procedure was validated in laboratory percolation tests using 10 columns filled with well graded sand. The calculated quantities of water during these trials agreed well with the actual amounts of water collected from each column. The procedure is simpler than traditional percolation rate tests, but its validity for layered soil profiles or shallow groundwater table conditions has yet to be ascertained. When performing in situ measurements using the neutron moisture probes, consideration should be given to the method of installation of the access tube, the time intervals at which moisture contents will be recorded at each site, the distance between levels where moisture content values are taken, and the depth from the ground surface to the level where moisture content readings are recorded. (Geiger-FRC)
W82-04309

THE RESPONSE OF GROUNDWATER TO ARTIFICIAL RECHARGE SCHEMES,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Water Resources Research, Vol 17, No 6, p 1712-1714, December, 1981. 3 Fig, 3 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Aquifers, Mathematical studies, Groundwater movement, Recharge, *Groundwater management, Unconfined aquifers, Groundwater storage, Transmissivity, Seasonal variation.

Analytical solutions for the groundwater flow in an unconfined aquifer showed that uniform recharge rates over the whole period of recharge are not the optimal solution. A greater net gain (up to 24%) in aquifer storage and outflow can be obtained by distributing the recharge volume over several periods of variable duration. Artificial recharge can be scheduled, knowing the effects of seasonal variations in infiltration. (Cassar-FRC)
W82-04337

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,
International Engineering Co., Incorp., San Francisco, CA.
For primary bibliographic entry see Field 2F.
W82-04428

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 16, No 5, p 866-873, October, 1980. 5 Fig, 23 Ref.

Descriptors: *Groundwater, *Geohydrology, Groundwater hydrology, *Model studies, *Groundwater movement, Computers, Hydrologic models, Simulation, Water resources development, Water supply development.

A solution for the inverse problem in groundwater has been proposed, based on the lumped approach. For the purpose of illustrating the solution procedure, a hypothetical aquifer having impermeable boundaries was considered. Of primary concern was the demonstration of the validity of the approach and the observance of the convergence characteristics of the search algorithm. The aquifer is unconfined, having uniform depth of 100 ft, overlying a horizontal impermeable bed. It is 8000 feet wide and 12,000 feet long and has five pumping wells of various capacities. The inverse model uses a simulation model and approximate boundary conditions to generate values for surrogate permeabilities such that the model output agrees reasonably with the observed data. The emphasis is on the determination not of the conventional aquifer permeability, but of a surrogate permeability, so that the model can eventually be used for the management studies. The surrogate permeability should not be interpreted as a property of the porous media. It is simply a transformation constant in the management model. The advantage of such an approach is that the system complexities that are hard to determine essentially become incorporated into the surrogate parameters. The proposed method also allows the same ground water flow equations and the same solution procedure with the same initial and boundary conditions to be employed both in the identification process and in the subsequent management studies. This tends to minimize errors inherent in a simulation process. (Baker-FRC)
W82-04451

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-133448, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-57, 1981. 10 p, 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Borehole geophysics, *Groundwater, *Water management, *Data collections, Aquifers, Observation wells, Monitoring, Geohydrology, Carbonate rates, Water quality, Water level, *Florida, *Floridan aquifer.

Management of ground-water resources within the Southwest Florida Water Management District requires that hydrogeologic characteristics of water-bearing rocks and quality characteristics of water be described. Wells for the District's Regional Observation and Monitor Well Program are drilled specifically to collect data to describe the groundwater resource. Suggested borehole data-collection methods for these wells include drilling in stages; running geophysical logs at the completion of each stage; collection of water-level and specific-conductance data before, during, and after a day's drilling; specific-capacity determinations after a day's drilling; and placing a packer in the gypsiferous and anhydritic limestone and dolomite for water-level and water-quality data. (USGS)
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
M. P. Bergeron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137688, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-38, August, 1981. 73 p, 33 Fig, 7 Tab, 25 Ref.

Descriptors: *Groundwater, *Irrigation, *Pumping, *Surface-groundwater relations, Groundwater movement, Model studies, Simulation analysis, Aquifers, Aquifer characteristics, Bedrock, Water level fluctuation, Drawdown, Glacial drift, *Groundwater mining, Groundwater recharge, *Indiana, Newton County, Jasper County, Hydraulic conductivity.

Flow in the ground-water system in Newton and Jasper Counties, Indiana, was simulated in a quasi-three-dimensional model in a study of irrigation use of ground water in the two counties. The ground-water system consists of three aquifers: (1) a surficial coarse sand aquifer known as the Kankakee aquifer, (2) a limestone and dolomite bedrock aquifer, and (3) a sand and gravel bedrock valley aquifer. Irrigation pumping, derived primarily from the bedrock, was estimated to be 34.8 million gallons per day during peak irrigation in 1977. Acreage irrigated with ground water is estimated to be 6,200 acres. A series of model experiments was used to estimate the effects of irrigation pumping on ground-water levels and streamflow. Model analysis indicates that a major factor controlling drawdown due to pumping in the bedrock aquifer are the variations in thickness and in vertical hydraulic conductivity in a semiconfining unit overlying the bedrock. Streamflow was not significantly reduced by hypothetical withdrawals of 12.6 million gallons per day from the bedrock aquifer and 10.3 million gallons per day in the Kankakee aquifer. Simulation of water-level recovery after irrigation pumping indicated that a 5-year period of alternating between increasing pumping and recovery will not cause serious problems of residual drawdown or ground-water mining. (USGS)
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
S. J. Kent, R. A Engberg, and M. J. Ellis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129115, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-58, 1981. 34 p, 14 Fig, 5 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Geohydrology, *Groundwater availability, Water table, Irrigation wells, Water yield, Sampling, Water analysis, *Nebraska, *Crofton unit.

This report describes sources, locations, quantity, and quality of ground water in a 350-square-mile area whose potential for irrigation development is being evaluated by the U.S. Bureau of Reclamation. The entire area is underlain by Precambrian Sioux Quartzite, which throughout most of the area is overlain by undifferentiated Paleozoic rocks. The Sioux and, where present, Paleozoic rocks are overlain unconformably by Cretaceous formations, including the Dakota and Niobrara Formations. Surface strata are Pleistocene and Holocene deposits of sand and gravel and Pleistocene glacial till. The Dakota and Niobrara Formations are each capable of yielding water sufficient for irrigation wells in parts of the area. Pleistocene and Holocene deposits yield adequate water for irrigation in the southern part of the area and along the flood plain of the Missouri River. Water from the Dakota Formation is so saline as to necessitate burdensome salinity-control measures for successful long-term irrigation use. That from the Niobrara Formation is suitable for irrigation of most crops. Water from Pleistocene and Holocene deposits is highly variable, but is suitable for irrigation in the southern part of the area and along the Missouri River. (USGS)
W82-04498

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN-GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),
Tubingen Regierungspresidium (Germany, F.R.).
H. Bartel.
Wasserwirtschaft, Vol 71, No 11, p 313-318, November, 1981. 4 Fig, 3 Ref. English summary.

Descriptors: *Road construction, *Watershed protection, *Karst hydrology, Aquifers, *Groundwater protection, *Germany, Runoff, Construction materials, Costs, Turbidity, Oil spills, Water treatment, Impervious boundaries, Imported water, Water pollution control, Erosion control, Geology.

Water supply is a major government objective in the State of Baden-Wurttemburg, since available

groundwater reserves are concentrated in limited areas, while the remainder of the territory has inadequate local supplies. A major international highway, Autobahn A81, is under construction in this State. The vulnerability of the groundwater in the karstic formations is intensified by highway construction and anticipated petroleum pollution. In highway planning, important water-bearing formations were circumvented insofar as possible, but collecting regions are traversed over a distance of 24 km. Water protection plans were developed cooperatively by highway engineers, water supply planners and geologists. Where the clay marl layer generally overlying the karst was lacking, a special impermeable layer was applied in preparation of the roadbed. Piping was installed to divert highway runoff to suitable infiltration areas with oil protection. Fissures and cavities exposed during construction were also sealed with impermeable materials such as clay or cement. Protection costs were estimated at 9.6 million German Marks. Water supply security was simultaneously improved by installing additional filtration and biological equipment in affected water supply plants. Where the protection offered by these measures was judged inadequate, provisions were made for permanent or emergency water important. (Carroll-FRC)
W82-04551

LOCAL IRRIGATION AGENCIES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Revesz, and D. H. Marks.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 329-338, October, 1981. 1 Tab, 10 Ref. OWRT 14-34-0001-9430.

Descriptors: *Irrigation districts, *Conjunctive use, *Water management, Model studies, Water policy, Water law, Local governments, Water distribution, Water management, Public policy, Water districts, Groundwater management, Institutions, Legal aspects, Planning.

The history and nature of irrigation institutions in the U.S. are described. Mathematical models of irrigation supplies assume that comprehensive irrigation management exists. In reality, the three major types of irrigation agencies (public irrigation disricts, mutual water companies, and commerical water companies) have limited power. With few exceptions, they have no direct control over groundwater depletion. Public irrigation districts are most powerful, followed by mutual companies, then by commerical water companies (which have virtually disappeared). Conjunctive use modelers should rely only on those decision variables controlled by the particular agency under study. (Cassar-FRC)
W82-04560

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
J. K. White.
Civil Engineering (London), p 27, 29-31, December, 1981. 10 Fig.

Descriptors: *Construction methods, *Groundwater management, Unconfined aquifers, Confined aquifers, Dewatering, Groundwater level, *Excavation, Urbanization, Industrial development, *Coastal areas, Estuaries, *Water table.

Urban and industrial development occurring near rivers, coastal areas and estuaries where the water table is closest to the ground surface frequently calls for control of groundwater to be undertaken. Two types of control are considered. The first occurs when a foundation excavation goes below the water table in a saturated permeable material, such as gravel or sand, which lies above a substantial impermeable base. The second type of situation occurs when the excavation is in a relatively dry impermeable strata, which is near the surface but which overlies a saturated permeable material in which the water pressure would cause the water level in a stand pipe located in it to rise above the formation level of the foundation. Under these circumstances there is the risk that removal of the excavating material will cause sufficient imbalance between overburden and water pressure for the water to break through and flood the excavation. The method of control adopted will vary and depends on the circumstances. While experience plays a large and essential part in the specification of a dewatering system, there has been a growing demand in recent years for analytical justification for design. Models have been devised which are used to give more reliable estimates of well point performance when used in conjunction with sheet pile cut-offs in those cases where both the system and the cut-off partially penetrate an unconfined aquifer. (Baker-FRC)
W82-04714

4C. Effects On Water Of Man's Non-Water Activities

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
W. J. Rawls, A. Shalaby, and R. H. McCuen.
Transactions of the ASAE, Vol 24, No 6, p 1562-1566, November/December, 1981. 3 Fig, 5 Tab, 11 Ref.

Descriptors: *Urban runoff, *Hydrologic models, *Land use, Urban hydrology, Soil types, Rainfall-runoff relationships, Antecedent moisture, Soil water, Runoff curve number.

The runoff curve number, an important input parameter to the Soil Conservation Service's hydrologic models, integrates land cover, soil type, and antecedent soil moisture conditions. Data from 175 urban watersheds were used to determine runoff curve number by three methods: the contingency table approach (measuring the fractions of land use and soils separately and integrating them with a weighted average scheme), use of the U.S. Geological Survey land use maps, and the conventional approach (use of the overlay method with low altitude aerial photos, land use maps, and onsite investigations). Results indicated that estimates of runoff curve numbers were sensitive to the land use classification system and relatively insensitive to the method of integrating soils and land cover data. The detailed, time-consuming conventional approach was not necessary for watersheds of greater than 26 sq km. A set of runoff curve numbers was calculated for the three hydrologic soil groups for Level II U.S. Geological Survey land use categories. Although these were not in total agreement with those estimated by the conventional approach, the level of imprecision was considered satisfactory for most hydrologic studies. (Cassar-FRC)
W82-04535

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, and N. P. Kobriger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241895, Price codes: A06 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/042, February, 1981. 121 p, 16 Fig, 37 Tab, 169 Ref. DOT-FH-11-8600.

Descriptors: *Highways, *Roads, *Water pollution sources, *Storm runoff, *Urban runoff, Drainage effects, Particulate matter, Deicers, *Highway effects, Environmental effects, Heavy metals, Pesticides, Oxygen demand, Salt.

The factors which most affect quantity and quality of highway runoff are traffic volume, rainfall intensity and pattern, highway drainage characteristics, operation and maintenance characteristics and degree of imperviousness of the drainage area. Maintenance of adequate drainage is one of the most important aspects of highway design. Highway runoff characteristics are similar to those of urban runoff and may exert significant shock pollutional loads on receiving waters. The weighted average of total solids accumulations between successive street cleanings, a period of 2 to 12 days, for eight cities was found to be 1400 lb/curb mile. A high percentage of street surface pollutants are associated with very fine dust and dirt particles. Substantial quantities of toxic materials, such as heavy metals and pesticides, are present in street surface contaminants with the amounts varying considerably from site to site. Because of the consistent presence of heavy metals in amounts large enough to interfere with BOD5 measurements, COD is considered to be a better parameter for measuring the oxygen demand potential of highway runoff. Highway salting rates usually range from 400 to 1200 lbs per two-lane mile. Over the winter season, a typical multiple lane highway may use 100 tons or more of salt per mile. Significant amounts of vehicle released airborne matter are settled out and washed off the road surface during rainstorms. (Moore-SRC)
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5A.
W82-04628

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04637

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,
Sir William Halcrow and Partners, London (England).
For primary bibliographic entry see Field 2A.
W82-04683

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
D. D. Richter, C. W. Ralston, and W. R. Harms.
Science, Vol 215, No 4533, p 661-663, February 5, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Forest management, *Water quality, Cycling nutrients, Phosphorus, Sodium, Nitrogen, Carbon, Calcium, Magnesium, Water pollution sources, Groundwater, Forest soils, Hydrology, Nutrients, *Forest fires, Environmental effects, Runoff.

This report examines both off-site and on-site effects of a series of prescribed fires on experimental watersheds in the Lower Coastal Plain of South Carolina. Studies of off-site effects were concerned with fire-caused exports of materials from a pine forest ecosystem to drainage waters and the atmosphere, while on-site effects focused on the magnitude and extent of hydrologic fluxes of nutrients from burned litter to mineral soils and ground waters. Hydrologic nutrient fluxes from burned

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forest floors were evaluated from the nutrient contents of litter samples collected immediately after the fire and again after postburn rainfall of about 15 cm. The contents of total nitrogen, phosphorus and sulfur in burned forest floors were not significantly changed by the initial rainfall. Analysis of mineral soil collections before fire and after fire and rain indicated minor effects of fires on mineral soil chemical properties, despite variations in fire intensities and in postburn leaching conditions. The changes in total mineral soil carbon, nitrogen and phosphorus were small. No fire effects were observed on specific conductance, pH, or dissolved concentrations of ammonium, nitrates, phosphates, sulfates, chlorides, calcium, magnesium, potassium or sodium in ground waters collected from surface soil and subsoil horizons. No changes were noted in the chemical constituents of streams which could be attributed to the fire treatment. (Baker-FRC)
W82-04690

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04714

4D. Watershed Protection

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,
Snake River Conservation Research Center, Kimberly, ID.
M. J. Brown, J. A. Bondurant, and C. E. Brockway.
Transactions of the ASAE, Vol 24, No 6, p 1478-1481, November/December, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Sedimentation basins, *Phosphorus removal, *Agricultural runoff, Irrigation, Drainage water, Surface drainage, Ponds, Sediment control, Suspended sediment, Water pollution control, Erosion control, Runoff, Idaho, Sediment removal.

A 3400 cu m sediment retention pond receiving surface water runoff from 4050 ha of irrigated land in Idaho removed sediment and phosphorus at greater than design efficiency (50% of total sediment input) for the 5-year observation period, 1972-1976. Removal efficiencies were 65-76% for sediment and 25-33% for total P. Phosphorus passing through this pond was either soluble or attached to soil particles too small to settle without flocculation. Average daily flow through the pond during the irrigation runoff period, April-November, was 347 liters per sec, and average retention time was 2.7 hours. Removal efficiency generally increased with increasing flow rate. A stream flow of 340-453 liters per sec removed sediment most efficiently. Very high flow rates did not allow even silt particles to settle. Optimum sediment concentration was 20-750 mg per liter. (Cassar-FRC)
W82-04358

TOPSOIL MANAGEMENT OF MINED SOILS,
Science and Education Administration, Cheyenne, WY.
G. E. Schuman, and J. F. Power.
Journal of Soil and Water Conservation, Vol 36, No 2, March/April p 77-78, 1981. 23 Ref.

Descriptors: *Land reclamation, *Topsoil, *Resources management, *Strip mine wastes, *Strip mines, Soil management, Soil properties, Crop yield, Runoff, Infiltration, Watershed protection.

Federal and state laws require that strip mined land be reclaimed to a level of productivity equal to or greater than that which existed before the mining. Topsoil must be removed before the mining operation and redistributed over the graded overburden after the coal has been removed. Studies on necessary topsoil depth found maximum grass yields with a subsoil depth of 28 inches and a topsoil depth of 8 inches. Another study found topsoil depths of 8 and 16 inches to give good yields. Topsoil plays a major role in water infiltration; infiltration increases with topsoil depth. Some studies have found that the major portion of a root system is limited to the topsoil. Forage grown on reclaimed mine areas is generally of lower quality than that grown on adjacent land. This may be a result of topsoil stockpiling which causes shifts in soil fungal dominants and the loss of other microorganisms. In general, topsoil provides a good rooting medium, improves infiltration, reduces runoff, and encourages faster establishment of nutrient cycles. It also usually increases the species diversity of vegetational cover. (Small-FRC)
W82-04571

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATING MEDIUMS AND PLATING TECHNIQUES FOR ENUMERATING BACTERIA IN WATER DISTRIBUTION SYSTEMS,
Southern California Metropolitan Water District, LaVerne.
E. G. Means, L. Hanami, H. F. Ridgway, and B. H. Olson.
Journal of the American Water Works Association, Vol 73, No 11, p 585-590, November, 1981. 1 Fig, 7 Tab, 13 Ref.

Descriptors: *Bacterial analysis, *Culture media, Microbiological studies, Chlorination, *Drinking water, Water distribution, Membrane filtration, *Pollutant identification, Water analysis, Agar, Unchlorinated water, Comparison studies.

Media and plating techniques for bacterial enumeration were evaluated using 2 drinking waters, one chlorinated surface water and the other unchlorinated groundwater. Samples were collected bimonthly from June 1978 to September 1979. Media were plate count agar, R-2A low nutrient agar, and m-standard plate count agar. Incubation temperatures were either 20 or 35 C. The techniques were spread plate, pour plate, and membrane filtration. The m-standard plate count medium with membrane filtration recovered bacterial from the water systems most efficiently. The spread plate technique was better than the pour plate technique for counting the total and pigmented bacteria in both waters. The different media tended to select for particular subpopulations. There were also discrepancies in bacteria recovery efficiencies between the chlorinated and unchlorinated waters. In view of this evidence the pour plate method should be replaced with alternative methods for enumerating bacteria in water distribution systems. (Cassar-FRC)
W82-04277

EVALUATING STREAM STANDARD VIOLATIONS USING A WATER QUALITY DATA BASE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, and R. C. Ward.
Water Resources Bulletin, Vol 17, No 6, p 1071-1078, December, 1981. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Standards, *Water quality, *Variability, Effluent standards, Monitoring, Sampling, Model studies, Regulations, *Pollutant identification, Seasonal variation, Streams, *Sangamon River, *Illinois, Dissolved oxygen, Specific conductivity.

Two models (normal and nonparametric) for the behavior of a water quality random variable are reviewed. These models gave similar results when used with a water quality data base to describe the past behavior of a water quality variable relative to a stream standard and to evaluate apparent changes in the frequency of standard violations. They help to determine whether violations of standards are a result of natural variability or quality degradation. Cumulative density functions for water quality random variables were estimated using data from a routine grab sampling program, then were used to estimate the probability that a single grab sample will violate a given stream standard and to determine the anticipated number of violations in a given number of samples. Confidence limits about a point on the cumulative density function may be used to reflect the accuracy with which the sample estimate represents the true cumulative density function. The procedure, intended for use by state regulatory agencies, was illustrated using specific conductance and dissolved oxygen in the Sangamon River, Illinois. (Cassar-FRC)
W82-04286

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04324

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,
Texas Univ. at Austin. School of Public Health.
For primary bibliographic entry see Field 5C.
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,
Ife Univ. (Nigeria). Dept. of Environmental Health.
For primary bibliographic entry see Field 5C.
W82-04342

ANALYTICAL QUALITY CONTROL,
For primary bibliographic entry see Field 5G.
W82-04345

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,
National Inst. for Water Research, Pretoria (South Africa).
E. M. Nupen, and J. S. Burger.
Water SA, Vol 7, No 4, p 216-222, October, 1981. 4 Tab, 23 Ref.

Descriptors: *Swimming pools, *Microbiological studies, *Disinfection, Pollutant identification, Water treatment, Recreation facilities, Water quality, Public health, Bacteria, Coliforms, *South Africa, Chlorination, Drinking water, Mineral water.

Drinking waters, mineral waters, rheumatic treatment bath waters, and recreational hot and cold swimming pool waters in seven South African resorts were examined microbiologically. No viruses were isolated from recreational or drinking waters. Candida albicans was found in only 1 sample. Bacterial counts of most waters did not exceed accepted limits. Chlorine was effective as a disinfectant. It is suggested that drinking waters at resorts be monitored constantly and that children's swimming pools should have their own filtration-disinfection system. (Cassar-FRC)
W82-04348

DETERMINATION OF VOLATILE ORGANICS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
California Analytical Lab., Sacramento.
J. L. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-119090, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-071, December, 1981. 7 p, 5 Tab. 68-03-2033.

Descriptors: *Wastewater analysis, *Volatile organic compounds, *Gas chromatography, Electron capture gas chomatography, Industrial wastewater,

Municipal wastewater, Sample preservation, Halogenated hydrocarbon, *Organic compounds, Volatility.

Methodologies for the analysis of volatile organic compounds in industrial and municipal wastewater were developed and evaluated, using gas chromatography (GC) with flame ionization, electron capture, and Coulson detectors. Although no single GC column was found that gives complete chromatographic separation of all 36 of the test compounds, several packing materials were identified that provide good separation of all but a few compounds. All the test compounds were detected by one or more of the analytical approaches studied at levels of 1 ppb or less. The nonhalogenated compounds were not detected by Coulson or electron capture. Many of the compounds are detectable at levels of 0.1 ppb or lower. The addition of preservatives to reduce residual chlorine in aqueous samples was found to help maintain the chemical stability of the samples. The major limitation of all the analytical approaches investigated was the lack of specificity of detection. The flame ionization detector was the only detector that was able to detect the nonhalogenated compounds. However, it was the least specific of the detectors studied. For relatively clean wastewaters, a combination of the analytical methods was found to usually be both specific and sensitive. For grossly polluted wastewaters, interferences became such a severe problem that qualitative identification was not feasible. (Moore-SRC)
W82-04396

DETERMINATION OF HALOETHERS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Monsanto Research Corp., Dayton, OH.
P. L. Sherman, J. M. Kyne, R. C. Gable, J. V. Pustinger, and C. R. McMillin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-123290, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-062, December, 1981. 5 p, 1 Fig, 4 Tab. 68-03-2033

Descriptors: *Haloethers, *Wastewater analysis, *Gas chromatography, *Chlorinated hydrocarbons, Municipal wastewater, Industrial wastewater, Ethers, Chemical analysis, Water analysis, Sample preservation.

The following haloethers were originally included in this study: 2-chloroethyl vinyl ether, bis(2-chloroisopropyl) ether, bis(2-chloroethyl) ether, bis(2-chloroethoxy) methane, 4-chlorophenyl phenyl ether, and bis(chloromethyl) ether. The 2-chloroethyl vinyl ether and bis(chloromethyl) ether were later deleted from the project because of extreme volatility and hydrolytic instability, respectively. A literature search was conducted to acquire published information on the hydrolytic stability of the haloethers, methods for the detection of haloethers in water, and methods for the isolation, concentration and analysis of haloethers. The workable method developed in this program for the analysis of haloethers in wastewater consisted of a liquid/liquid evaporators, a column chromatographic clean-up procedure using Florisil, another K-D evaporation of the fraction from the Florisil column, and subsequent analysis by gas chromatography using an electrolytic conductivity detector. Sample preservation was studied at various pH and residual chlorine levels and different temperatures. The stability of haloethers stored in acetone and in methanol was observed. (Moore-SRC)
W82-04398

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,
BDM Corp., Albuquerque, NM.
J. F. Dawson, K. E. Hain, B. McClure, R. E. Sheridan, and J. G. Yeager.
Environmental Protection Agency Project Summary EPA-600/S1-81-049, October, 1981. 5 p, 1 Fig.

Descriptors: *Computer models, *Pathogens, *Parasites, *Bacteria, *Viruses, *Sludge disposal, Wastewater treatment, Enteroviruses, Salmonella, Poliovirus, Ascaris, Mathematical models, Public health, Simulation, Fate of pollutants.

A computer model was developed to predict the numbers of specific pathogens that would be found in sewage sludge at various points during sludge treatment and application, along 13 defined pathways. These pathways describe the use of dried or liquid, raw or anaerobically digested sludge as a cropland fertilizer, dried raw sludge as an animal feed supplement, and composted sludge as a residential soil amendment. Three organisms were selected to represent the enteric pathogens most commonly found in sludge: Salmonella species were used to represent the bacteria; Ascaris species were used to represent parasites; and polioviruses were used to represent all enteric viruses. The model uses a compartment-vector approach in which a mathematical state represents a discrete point in a treatment or application pathway where pathogen populations are computed as a function of time. Within these compartments, mathematical process functions describe population changes due to environmental factors. Pathogen exchanges between compartments are described by transfer functions. The model permits user speciication of various parameters in both process and transfer functions, for simulation of a unique set of environmental conditions. The model has the additional capability of performing exposure risk calculations for environmental compartments specified by the model user at the time of model variable initialization. (Moore-SRC)
W82-04403

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALT-WATER INTERFACES IN COASTAL AQUIFERS.
University of South Florida, Tampa. Dept. of Geology.
T. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211459, Price codes: A04 in paper copy, A01 in microfiche. Publication No 60, September, 1981. 57 p, 27 Fig, 2 Tab, 28 Ref. OWRT A-043-FLA(1). 14-34-0001-1110.

Descriptors: *Remote sensing, *Geophysical surveys, Saltwater interfaces, Coastal aquifers, *Saline-freshwater interfaces, Electromagnetic waves, Conductivity, Measuring instruments.

In coastal areas salt-water intrusion represents a significant threat to water quality in coastal aquifer systems. The electromagnetic method evaluated in this study proved to be rapid, very inexpensive, and it yields results which agree well with geologic and geochemical surveys using direct sampling. The instrument reads directly in conductivity units, and the depth of investigation is constant for a particular spacing and orientation of the receiver and transmitter coils. Data can be obtained and interpreted by personnel with little technical training. Data interpretation normally involves contouring terrain conductivity maps, but quantitative solutions can be obtained where the geoelectric section can be reasonable approximated by a two-layer section. Some problems were experienced with interference. However interference sources usually were very localized and could be avoided. This study in two areas of Florida demonstrates that the EM conductivity method is very useful for rapid, inexpensive ground water surveys where the objective is to locate zones of conductive pore fluids at depths less than 30-40 meters. Although interpretation is indirect and qualitative, neither data aquisition nor interpretation require special training. This characteristic of the EM method makes it very suitable for use by agencies where highly-trained technical personnel are not available.
W82-04412

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
G. D. Barnes, B. S. Dhillon, and A. S. Hume.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211467, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, December, 1981. 70 p, 20 Fig, 18 Tab, 48 Ref. OWRT B-028-MS(1). 14-34-0001-1239.

Descriptors: *Water pollution, *Trihalomethanes, Silver bromide, Silver bromate, *Bromides, Potassium bromide, Species diversity, Mean numbers of organisms, Community composition, Zooplankton, Decay rates of trihalomethanes, *Phytoplankton, Toxicity, Water treatment, Potable water, *Pearl River, *Jackson, Mississippi, Daphnia, Cyclops.

Significant differences in a completely randomized block design were found in species diversity (d) and mean numbers of phytoplankton in microcosms by the following treatments when compared to a control: total trihalomethane levels (1, 10, 1000 and 100,000 ppb); potassium bromide levels (1, 10 and 1000 ppb); silver bromide levels (1, 10, 1000, 10,000 and 100,000 ppb) and silver bromate (1, 10 and 1000 ppb). Toxic threshold levels for algae were between the two highest levels in THM and silver bromide respectively. Daphnia sp. and Cyclops sp. mortality increased with increasing levels of treatments: total trihalomethanes (1, 10, 100 and 1000 ppb); silver bromides (1, 10, 1000 and 10,000); silver bromates (1, 10, 1000 and 10,000). The high level of silver bromate was extremely toxic in both experiments to Daphnia and Cyclops. Percent decay rates for chloroform, bromodichloromethane, chlorodibromomethane and bromoform were similar at all time intervals throughout the study. By 11.3 hrs., approximately fifty percent of all the trihalomethanes were depleted from the microcosms. From computer projected decay rates, chloroform and bromoform were depleted from the microcosms by 80 hrs.
W82-04413

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,
Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W82-04416

MEMBRANE FILTER METHOD FOR ENUMERATION OF ACINETOBACTER CALCOACETICUS FROM ENVIRONMENTAL WATERS,
Rhode Island Univ., Kinston. Dept. of Microbiology.
S. J. LaCroix, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol 43, No 1, p 90-96, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Membrane processes, *Bacteria, Ponds, Filtration, *Bacterial analysis, Separation techniques, Lakes, Nutrients, Microbiological studies, Acinetobacter calcoaceticus, Pathogenic bacteria, Pollutant identification.

The aim of this study was to develop a selective-differential procedure for the quantification of Acinetobacter calcoaceticus as the first step in better defining the ecology of the organism. The procedure developed uses a mineral medium, with sodium acetate and potassium nitrate as the carbon and nitrogen sources, respectively. The recovery of A. calcoaceticus was enhanced through the introduction of formic acid, which also inhibited background growth. After incubation at 30 degrees C for 46 hr, fermentation and cytochrome oxidase tests were performed on the colonies as they appeared on the membrane. Background microbial growth decreased on the average by 1.77 orders of magnitude. An essentially quantitative recovery relative to that on nutrient agar spread plates was obtained from freshly prepared suspensions of eight A. calcoaceticus strains in filter sterilized pond water at 15 and 22 degrees C. With the three remaining strains markedly reduced relative recoveries were obtained. However, these three strains, in contrast to the first five, not only did not grow,

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but also decreased in number in the eutrophic, filter sterilized pond water. The confirmation rate of presumptive A. calcoaceticus colonies was 95%, whereas 8% of the presumptively negative colonies were A. calcoaceticus. Densities of A. calcoaceticus in freshwaters ranged from less than 1 to 79,000 organisms per 100 ml water and were about 1,000,000 organisms per 100 ml in raw sewage. (Baker-FRC)
W82-04453

A SIMPLE MICRODETERMINATION OF POLYMER FLOCCULANTS (POLYACRYLAMIDES AND GUAR) IN MINE WATER,
Anglo American Research Lab., Johannesburg (South Africa).
E. Jungreis.
Analytical Letters, Vol 14, No A14, p 1177-1183, 1981. 3 Tab, 8 Ref.

Descriptors: *Mine drainage, *Chemical analysis, Filtration, Membrane filters, Filters, Membrane processes, *Polymers, Guar, Polyacrylamides, Flocculation, *Wastewater analysis.

A method is presented for the microdetermination of polymer flocculants in mine water by measuring the laminar flow rate through a membrane filter under vacuum. The procedure calls for filtering the mine water sample through an 8.0 micrometer millipore filter, measuring the pH, and filtering 50 ml of this pretreated sample through a 0.22 micrometer 25 mm diameter millipore filter under vacuum. The filtration time is measured. A calibration graph is prepared at the same temperature, same pH, same vacuum conditions and the same filtering system, with freshly prepared polymer flocculant solution of the same kind. The concentration of the unknown is determined from the time-concentration plot. The precision of the method is acceptable. (Baker-FRC)
W82-04457

DETERMINATION OF TRACE INORGANIC POLLUTANTS (CU, PB, CD, ZN) IN WATERS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY AT A ROTATING MERCURY FILM ELECTRODE (DOSAGE DE MICROPOLLUANTS MINERAUX DES EAUX (CU, PB, CD, ZN) PAR VOLTAMPEROMETRIE DE REDISSOLUTION ANODIQUE IMPULSIONNELLE SUR ELECTRODE TOURNANTE A FILM DE MERCURE),
Parisien Lab. Regional de l'Est, Le Bourget (France).
M. Bouzanne.
Analysis, Vol 9, No 10, p 461-467, December, 1981. 5 Fig, 11 Ref. English summary.

Descriptors: *Chemical analysis, *Water quality, *Heavy metals, Metals, Electrodes, Electrochemistry, Chemical interference, Dissolved oxygen, Natural waters, Copper, Lead, Cadmium, Zinc.

Various anodic stripping techniques seem promising for rapid, simple determination of trace inorganic pollutants, especially heavy metals, in natural waters. Differential pulse anodic stripping voltammetry using a preconcentrated phase is inherently more sensitive than direct electrochemical methods such as pulse polarography. A rapid deoxygenation apparatus was developed for use with this method, which was then applied for heavy metal determination in 500 samples of various natural waters. Operating conditions such as pulse duration, electrolysis potential, and final potential depend to some extent on the nature and concentration of the supporting electrolyte. The duration of electrolysis, electrode rotation speed, and measurement scale were adjusted after a preliminary tracing was obtained. Use of an internal standard is recommended rather than a calibration curve because of possible variations between samples due to the presence of traces of surfactants or dissolved oxygen and alterations in the mercury distribution. Interference due to the formation of intermetallic compounds in simultaneous determinations can be eliminated by addition of suitable reagents such as gallium and germanium salts. Prior oxidation with potassium persulfate or UV photolysis can eliminate interference by traces of dissolved organic compounds. At the microgram per liter level, the coefficient of variation for eight successive determinations of lead, cadmium and copper was 1-1.5%, depending on the element examined. For a reasonable electrolysis time of 15 min, detection limits of 10 ng/l were achieved for lead and 5 ng/l for copper and cadmium. (Carroll-FRC)
W82-04458

ENTEROTOXIGENIC BACTERIA IN FOOD AND WATER FROM AN ETHIOPIAN COMMUNITY,
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Bacteriology and Epizootology.
S. F. H. Jiwa, K. Krovacek, and T. Wadstrom.
Applied and Environmental Microbiology, Vol 41, No 4, p 1010-1019, April, 1981. 1 Fig, 5 Tab, 57 Ref.

Descriptors: *Pollutant identification, *Pathogenic bacteria, *Bacterial analysis, Water pollution, Developing countries, Enteric bacteria, E. coli, Isolation, Separation techniques, Human diseases, Coliforms, Foods, Public health, *Ethiopia.

Forty of 213 bacterial isolates from Ethiopian food and natural water samples were capable of producing heat-labile enterotoxin (LT). Among the LT-producers Escherichia coli, Enterobacter, Klebsiella, Serratia, and Proteus were present. Enterotoxigenic isolates from food included oxidase positive strains of Aeromonas, Pseudomonas, Achromobacter, Flavobacterium, and Vibrio. LT-enterotoxigenic species from food and water samples included Enterobacter, Acinetobacter, Klebsiella, Proteus, Providencia, and Serratia. Several isolates gave positive reactions in Chinese hamster ovary cell tests and induced fluid accumulation in rabbit ileal loops. After storage in trypticase soy broth with glycerol at -70 degrees C for 9 months, only about 33% of the oxidase-positive strains were still LT enterotoxigenic. None of the E. coli isolates possessed K88, K99 or colonization factor antigen. Although this study showed that food and water contained enterotoxigens of the same species as those isolated from infantile diarrhea cases, no correlations were made between these pathogens and the incidence of infantile diarrhea in developing countries. (Geiger-FRC)
W82-04463

INFLUENCE OF DILUENTS, MEDIA, AND MEMBRANE FILTERS ON DETECTION OF INJURED WATERBORNE COLIFORM BACTERIA,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, S. C. Cameron, and M. W. LeChevallier.
Applied and Environmental Microbiology, Vol 43, No 1, p 97-103, 1982. 3 Fig, 2 Tab, 44 Ref.

Descriptors: *Bacteria, *Drinking water, Water analysis, Filtration, Membrane processes, Membranes, *Coliforms, Waterborne bacteria.

The recovery of coliforms both before and after substantial cellular injury in drinking water is examined with respect to the composition, exposure time, and temperature of the diluents; the composition of various media commonly used in water quality testing; and the surface pore morphology of membrane filters at 35 degrees C. Pure cultures of Escherichia coli, Klebsiella pneumoniae, Enterobacter aerogenes, and Citrobacter freundii were injured in water from a dead end section of the Bozeman, Montana, distribution system. The addition of peptone or milk solids to diluents and low temperatures of 4 degrees C maximized the recovery of injured cells but did not significantly affect undamaged cells. High efficiencies of recovery of control cells were noted on most media tested, but recoveries of injured cells ranged from 0 to nearly 100%. Less than 30% of the injured cells were recovered by most of the media commonly used in water analysis. This was done in part to the sensitivity of injured bacteria to deoxycholate concentrations greater than 0.01%, whereas control cells were unaffected by 0.1%. A negligible effect of membrane filter surface pore morphology on total coliform recoveries was noted at 35 degrees C. These findings support the development of new methodologies, allowing a more complete enumeration of injured coliforms in potable water and providing more accurate and dependable water quality information. (Baker-FRC)
W82-04469

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5B.
W82-04478

DETERMINATION OF TRACE ELEMENTS IN SEAWATER BY NEUTRON ACTIVATION ANALYSIS AND ELECTROCHEMICAL SEPARATION,
Oslo Univ. (Norway).
K. Jorstad, and B. Salbu.
Analytical Chemistry, Vol 52, No 4, p 672-676, April, 1980. 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Trace elements, *Water analysis, *Neutron activation analysis, Electrochemistry, Chemical reactions, Heavy metals, *Seawater, Electrolysis, Separation techniques, *Pollutant identification, Water pollution, Radioactive tracers, Radioisotopes.

In order to reduce the respective disadvantages of the individual methods, neutron activation analysis has been combined with electrodeposition on a mercury electrode to concentrate traces of reducible metals, leaving interfering elements in solution. This combination provides a useful multielement method for the determination of 28 elements in seawater. Samples which have been freeze-dried and irradiated are dissolved in dilute nitric acid and electrolyzed for 1 hour. Silver, arsenic, gold, cadmium, cobalt, chromium, iron, mercury, gallium, lanthanum, molybdenum, antimony, selenium, and zinc can be determined from the radioactive species deposited on the mercury cathode. After a radioactive decay time of 2 weeks, the following 14 elements can be determined by measuring the activities in the residual solution: barium, bromine, calcium, cerium, cesium, europium, sodium, rubidium, scandium, samarium, strontium, thorium, uranium, and ytterbium. Since only radioactive species deposited on the cathode or left in the solution are being measured, technical grade reagents can be used. In order to obtain a reproducible electrolysis, radioactive tracers have been used to study the decrease of element concentrations in solution as a function of time of electrolysis, the influence of the initial element concentration on the rate constant K, the effect of cathode material, and the effect of the pH in solution. The technique may be used for multielement analysis of other samples having a high content of interfering elements which are not deposited on the electrode, such as samples of biological or geologic origin. (Carroll-FRC)
W82-04530

AUTOMATIC MEASURING STATION FOR CONTINUOUS MONITORING OF RIVERS,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
H. B. Kloppel.
Water Science and Technology, Vol 13, No 11/12, p 683-686, 1981. 1 Fig.

Descriptors: *Monitoring, *Water quality, *Automation, Computers, Water management, Rivers, Data acquisition, Data collections, Turbidity, Hydrogen ion concentration, Dissolved oxygen, Conductivity, Wastewater treatment, *Effluents.

A measuring station is described which was developed for the constant monitoring of rivers or water with similar characteristics. It is equipped for automatic cleaning and calibration and can be monitored remotely by means of an integrated computer via MODEM and telephone connection. The parameters for water temperature, pH, dissolved oxygen, conductivity and turbidity are measured. The computer collects the test data. It carries out preliminary data processing and stores the data

until it is called up by telephone. In addition the computer accepts the commands for controlling the station via to a telephone connection. It transfers the commands to the control unit of the station, and reports back the operating condition of the station via telephone. The station can also be operated as an independent functional unit without a computer, and as such can be used for monitoring the final effluent of a sewage treatment plant without much maintenance. The measured values are then transmitted separately via cable to the control center of the treatment plant itself. The measuring station is provided with very effectively operating equipment for the automatic cleaning and calibration of the sensors so that the station can operate without supervision for 4 weeks. (Baker-FRC)
W82-04569

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,
Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-04575

CONTINUOUS MEASUREMENT OF ORGANIC SOLVENTS IN AIR AND WATER (KONTINUIERLICHE MESSUNG ORGANISCHER LOSEMITTEL IN LUFT UND WASSER),
Siegrist G.m.b.H., Hamburg (Germany, F.R.).
H. Fuhrmann.
Wasser, Luft und Betrieb, Vol 25, No 12, p 25-28. 1981. 8 Fig, 4 Ref. (No English Summary).

Descriptors: *Chemical analysis, *Solvents, *Measuring insruments, Industrial water, Indusrial wastewater, Organic compounds, Chemical industry, Separation techniques, Trace levels.

A flexible second generation measurement system was developed which can be applied to the measurement of organic solvents in air and water. The measurement principle is based on changes in the elecrical conductivity of heated gas semiconductors due to the presence of adsorbed reducing materials. Systems applicable to water include membrane-sensor systems immersed directly in the liquid to be measured and connected to the evaluation apparatus by cable; membrane systems immersed in the liquid to be measured, with continuous measurement provided by diffusion rate dilution with clean air, and continuously operating phase exchange systems with evaluation by gas sensors. The latter system avoids problems due to water contaminants in that only the volatile solvents are transferred into the gas phase. Range selection and calibration curves can be used to measure individual and total components. These instruments are particularly suitable for industrial applications. (Carroll-FRC)
W82-04579

CHLORIDE DETERMINATION IN AUTOMATED WATER COMPOSITION MONITORING (CHLORIDBESTIMMUNG IN DER AUTOMATISIERTEN WASSERBESCHAFFENHEITSKONTROLLE),
Institute fuer Wasserwirtschaft, Berlin (German D.R.).
H. Heitmann.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 341-342, 1981. 6 Ref. (No English Summary).

Descriptors: *Chlorides, *Chemical analysis, *Titration, Automation, Salinity, *Monitoring, Drinking water, Industrial water, River water, Saale River, *Elbe River, Potentiometry, Saline water intrusion, Germany.

Chloride levels in drinking water should not exceed 250 mg/l, since higher concentrations give a brackish taste. Chloride in industrial water corrodes iron, and chloride monitoring is also necessary as an indicator of saltwater intrusion. Possible methods of automated chloride monitoring include continuous potentiometric measurement of chloride ion activity with an ion-sensitive electrode and automated potentiometric titration of chloride ions with silver nitrate solutions. The former method is easier, but the latter method is more accurate, and therefore each of these methods is most suitable for specific applications. Use of continuous potentiometric chloride measurement is advantageous only where great accuracy is not required, for example for saltwater intrusion monitoring, so that an alarm can be sounded if a specific chloride level is exceeded. It is less useful for effluent monitoring because of possible interference by sulfide, bromide, iodide, cyanide and thiosulfate ions, as well as changes in the total salt content and temperature of the water. Automated electrode cleaning and calibration could improve accuracy beyont the presentplus or minus 15%. automated titration equipment is available which has a sample collection timing device. Mixing effects can introduce errors, especially in turbid samples, but can be controlled by slowing the rate of titration. Automated titration for determining the chloride input from the Saale into the Elbe iver over a number of years gave accuracy comparable to that of laboratory titration, (Carroll-FRC)
W82-04580

CONTINUOUS MONITORING OF THE EFFLUENT QUALITY OF AN ACTIVATED SLUDGE PLANT BY TURBIDITY MEASUREMENT (KONTINUIERLICHE KONTROLLE DER ABLAUFGUTE EINER BELEBTSCHLAMMANLAGE MITTELS TRUBUNGSMESSUNG),
Forschungszentrum Wassertechnik (German, D.R.).
K. Hanel, P. Liedke, W. Gutendort, and C. Anton.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 337-340, 1981. 5 Fig, 9 Ref. (No English summary).

Descriptors: *Activated sludge process, *Turbidity, *Process control, Sludge solids, Wastewater treatment facilities, Effluents, Sludge excess, *Monitoring, Automation, Measuring instruments.

The characteristics most frequently used for evaluating wastewater treatment effluent quality, such as BOD and filterable materials, are not suitable for rapid measurement, within a time period suitable for process control utilization. Other possible characteristics, such as chemical oxygen demand and total organic carbon, are not directly linked with the functioning of the activated sludge plant. Turbidity measurement has not been widely used for rapid estimation of effluent quality because of the difficulty of establishing a definite relationship between turbidity and other quality criteria in different waters. Sludge discharge was a frequent problem at the Wahren wastewater treatment plant. An attempt was made to monitor the occurrence of this phenomenon using a continuous light scattering turbidimeter, Nephelon II. Relatively close correlations were found between turbidity values, activated sludge content and BOD. Correlations were poor when large numbers of hydrophobic particulates were present following heavy rain and when incomplete biological purification was occurring, but errors were on the conservative side in these cases. If hydraulic conditions are favorable, measurements may be employed to control the operation of excess sludge pumps as long as safeguards against over-running are added. (Carroll-FRC)
W82-04583

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W82-04585

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,
H. Kunz.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Water quality, *Monitoring, *Weser River, Germany, Data acquisition, Automation, Water management, Oxygen, Acidity, Powerplants, *Wastewater, Mixing, Tidal rivers, Heated water, *Nuclear powerplants, *Tidal effects.

This paper describes the requirements placed on the Unterweser nuclear power plant (KKU) measurement system, the technical configuration, experience and results. The nuclear power plant operator must control his plant so as to remain within specified limits. The water authority responsible requires proof of this and carries out checks on the plant. In addition to thee temperature, the oxygen content, the conductivity and to a limited extent the pH value are also calculated. The measuring stations in the Unterweser have been placed as far out into the deep navigation channel as shipping permits because this offers the best point for presenting the applicable water quality conditions. The measurement station only records the values and transmits them to a central station when polled by radio. The stationary KKU water quality measurement system has available a fast measurement vessel as well as two meteorological measuring stations. These systems can both collect and record data themselves as well as be integrated in the data flow controlled from the central station. In contrast to tidal-free waters, the water level as well as the flow rates periodically vary with the tide, and sea water flows in. One and the same body of water passes a discharge point several times and is thus charged with waste water many times. Waste water discharged into the river may be carried by the tidal flow far beyond the discharge point. This complicated transporting and mixing process demands sophisticated measuring equipment to obtain data needed for control, monitoring and securing evidence of falling quality. (Baker-FRC)
W82-04588

CONTINUOUS WATER QUALITY MONITORING SYSTEM USING TELEMETRY IN THE CITY OF OSAKA,
Japan Sewage Works Bureau, Osaka.
K. Nanbo, and R. Kunogi.
Water Science and Technology, Vol 13, No 11/12, p 639-644, 1981. 3 Fig, 1 Tab.

Descriptors: *Water quality, *Monitoring, *Automation, Telemetry, Computers, Data acquisition, *Osaka, *Japan, Networks, Performance evaluation, *Wastewater facilities.

This paper summarizes the monitoring system used for water quality control in the city of Osaka, Japan, and lists items of importance for ensuring that the system operates at maximum efficiency and provides exact data. The central monitoring system is connected with the river monitoring stations, the sewage treatment plant monitoring stations and the factory monitoring stations by telemetry and collects data from them. Nine river, three sewage, and six factory monitoring stations have already been installed, and plans exist for 1, 10, and 4 additional stations, respectively. The central monitoring station is connected with each river and sewage treatment plant monitoring station through an allotted communication circuit and with factory monitoring stations through the public communication circuit. Data are collected every 5 minutes from river stations, every hour from sewage treatment plant stations and every day from factory stations, by a polling system. Various kinds of instruments are installed for telemetry, data logger and input-output of data in the central monitoring station. Proper maintenance is indispensable to get the most efficient operation from the equipment. It is hoped that the information being gained will aid the establishment of automatic water quality monitoring systems. (Baker-FRC)
W82-04590

THE AUTOMATIC MEASURING OF SEWAGE IN THE ARTOIS-PICARDIE AREA,
Artois-Picardie Agence de l'Eau, Douai (France).
J. -M. Journet.
Water Science and Technology, Vol 13, No 11/12, p 619-624, 1981. 2 Fig.

Descriptors: *Water quality, *Monitoring, Wastewater treatment, Automation, Data acquisition, Water management, Effluents, *Water pollu-

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tion sources, Watershed protection, Chemical analysis, Dissolved oxygen, Turbidity, *Waterways, *France.

In 1971 automatic monitoring of waterways was introduced into the Artois-Picardie area in northern France. This monitoring was found to be insufficient after a few years, and automatic monitoring of sewage was introduced. From 1975 on, two mobile stations were used to observe the natural conditions in the waterways of the catchment area and those affected by sewage pollution. The results showed the influence of nocturnal discharges from a cheese dairy upstream of the recording station on the quality of a small waterway. From 8 PM to 6 AM a significant increase of organic matter was noted, and a marked decrease in dissolved oxygen content. Subsequently an automatic Philips total oxygen demand meter and turbidimeters were tested on site with treated sewage and sewage containing industrial effluents. These were then included in the overall monitoring system in 1978 and 1979, with the building of four sewage monitoring stations. The results obtained by the end of 1980 concern 25 different types of discharge: paper mill, chemical, breweries, canning factories, iron and steel, domestic sewage and others. Plans for the future are briefly discussed. (Baker-FRC)
W82-04602

EVALUATION OF WATER QUALITY DATA RECEIVED BY AUTOMATIC CONTROL STATIONS AT THE TELTOW-CANAL IN BERLIN (WEST),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Chemieingenieurtechnik.
J. Schafer, H. Schumann, W. Niemitz, and U. Wiesmann.
Water Science and Technology, Vol 13, No 11/12, p 663-670, 1981. 7 Fig.

Descriptors: *Data collections, *Water quality, Automation, Monitoring, Canals, *Germany, *Teltow Canal, Berlin, *Effluents, Powerplants, Computers, Municipal sewage, Wastewater facilities.

The Teltow Canal is now one of the most heavily loaded waterways in Germany and contributes greatly to eutrophication of the lower Havel and the Havel lakes. This paper presents a first evaluation of water quality data from six automatic control stations along the canal. Mean values are given for each half year from 1972 through 1979 for concentrations of dissolved oxygen, temperature, conductivity and acidity. Changes in the distribution functions are given for diurnal mean values of oxygen concentration. A continuous degeneration of water quality over this time period was easily demonstrated. A special computer program was adapted to show the local and temporal changes in the data collected. Some of the results are presented as isolines for oxygen concentration and temperature. The increase in loading of the canal over the years was dramatic after the introduction of effluents from a new sewage treatment plant and another large power station. (Baker-FRC)
W82-04607

DETECTION AND MAPPING OF INSOLUBLE SINKING POLLUTANTS,
Rockwell International, Newbury Park, CA.
R. A. Meyer, M. Kirsch, and L. F. Marx.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105586, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-198, October, 1981. p, 5 Fig, 1 Tab. 68-03-2648.

Descriptors: *Water pollution, *Conductivity, *Acoustics, *Mapping, *Monitoring, *Hazardous materials, Carbon tetrachloride, Immiscibility, Solubility, Computers, Cleanup operations, Spills, *Pollutant identification.

Some of the hazardous materials spilled into rivers, streams, or lakes are immiscible, slightly soluble, and denser than water. These sinking pollutants must be detected at once, and their locations must be mapped to initiate cleanup operations and minimize impacts. An electrical conductivity monitoring system was developed to detect the rrival of sinking pollutants at the bottom of a watercourse. The submersible monitor uses a cyclically purged electrical conductivity probe capable of long-term deployment even when partially buried in sand or silt. The submersible unit, which is battery powered, will transmit the conductivity data to the shore-base receiver by means of ultrasonics. The unattended design life of the monitor is 1 year. A commercial 200-kHz depth-finder system has been extensively modified and tested for use in an underwater acoustic mapping system to locate pools when a spill of a sinking pollutant is known to have occurred. Laboratory tests indicate that the system is capable of resolving the echoes from the surface of a 1-cm deep layer of carbon tetrachloride from those returning from a hard, sandy, or muddy bottom. Field testing revealed few precursor echoes that might mask or interfere with the detection of an echo from a pollutant pool. Return echoes were evaluated by 16-mm motion picture photography, and a computer-based comparator-counter technique has been developed for data management. (Moore-SRC)
W82-04619

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, and T. L. Meinholz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241903, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/043, February, 1981. 121 p, 36 Fig, 9 Tab, 34 Ref, 3 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Water pollution sources, *Monitoring, *Runoff, *Water sampling, Flow measurement, Precipitation, Storm runoff, Land use, Site selection, *Highway effects, Environmental effects.

This manual has been prepared for use by highway department personnel to evaluate highway runoff. It contains detailed procedures for establishing and conducting a monitoring program and evaluating the collected data. There are a number of factors affecting the quality of the runoff that must be actively monitored for any site. Primary among these are traffic characteristics, highway operation and maintenance practices, precipitation characteristics, and the accumulation of pollutants on the highway. Other factors which must be noted because of their relevance to the quality of runoff include: adjacent land usage, right-of-way characteristics, roadway alinement, vertical plane, alinement of the highway, and pavement conditions. The steps required in establishing a successful monitoring program include: selection of a suitable site; planning a monitoring program; installing the monitoring equipment; maintenance and monitoring procedures; and evaluation and application of the results. A simple program may involve monitoring a single runoff event using manual sampling and flow monitoring techniques. A more complex program might involve monitoring events for an entire year or longer automated equipment. (Moore-SRC)
W82-04628

THE EFFECT OF STORAGE BY FREEZING ON DISSOLVED INORGANIC PHOSPHATE, NITRATE AND REACTIVE SILICATE FOR SAMPLES FROM COASTAL AND ESTUARINE WATERS,
Department of the Environment, Sidney (British Columbia). Inst. of Ocean Sciences.
R. W. Macdonald, and F. A. McLaughlin.
Water Research, Vol 16, No 1, p 95-104, January, 1982. 11 Fig, 4 Tab, 15 Ref.

Descriptors: *Sample preservation, *Nutrients, *Storage, Freezing, Silicates, Estuaries, Nitrates, Phosphates, Water sampling, Filtration, Thawing, Water analysis.

The effect of storage methods on stability of nutrients in coastal and estuarine waters was investigated. Parameters compared were freezing, quick freezing, filtering, and storage time. For phosphate, quick freezing produced better accuracy and precision in analysis. Filtration was necessary for turbid samples. Thaw time was not significant; storage time was significant for two of four samples, but examination of the data showed no clear trends. For nitrates, freezing was satisfactory; filtration was not necessary. Quick freezing slightly reduced the number of maverick samples. Freezing slightly decreased nitrate (1.6% for saline samples and zero for low salinity samples) and increased variance. Thaw time had no effects. In silicate determination, freezing was satisfactory for storage of saline water samples but not for low salinity estuarine samples, in which 5-15% of silicate was lost even after 24 hours that time. Quick freezing was better than regular freezing for the saline samples; filtering was not required. Samples should be analyzed for all three nutrients within two months after collection to limit variance caused by storage. (Cassar-FRC)
W82-04660

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,
Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2E.
W82-04663

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
C. E. Parker.
Journal Water Pollution Control Federation, Vol 54, No 1, p 77-86, January, 1982. 10 Fig, 33 Ref.

Descriptors: *Environmental effects, *Hazardous materials, *Toxins, Organic compounds, Wastewater, Water pollution sources, Bacteria, Cultures, Oxygen uptake, Adenosine triphosphatase, Pollutant identification, Water quality control.

In this paper the concept of using two microbial activities, adenosine triphosphate (ATP) and oxygen uptake, to quantify the strength of toxics in wastewater through a surrogate parameter is explored. Integrating short-term activity-time curves for various toxin concentrations and then correlating the activity-area curves with toxin concentration seem to be conceptually sound and offer one possible methodology for establishing a surrogate measurement of toxicity. The response of an ATP pool for a bacterial population to a toxic substance differs significantly from oxygen utilization. Because changes in the ATP pool are rapid and depend on the physiological state of the organism, standardization of the growth phase and of environmental conditions are essential. To eliminate the effect of the physiological state and to minimize fluctuations in the ATP pool, the ATP response to toxins is best measured during engogenous respiration and without substrate additions. The ATP activity response versus time for the endogenous culture could then reflect inhibition by the toxin. Toxins with the same activity-time response patterns may be quantified on the basis that equivalent areas represent short-term equivalent toxic effects. It has been shown that for several toxins the areas from activity-time plots for a bacterial culture can be related to toxin concentration. The ATP response is the more sensitive of the two activity measurements. Development of a bacterial bioassary procedure for surrogate toxin measurements will require the use of a pure culture. (Baker-FRC)
W82-04704

5B. Sources Of Pollution

WATER QUALITY PATTERNS DURING A STORM ON A MALL PARKING LOT,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.

Water Resources Bulletin, Vol 16, No 4, p 615-620, August, 1980. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Runoff, Fate of pollutants, Parking lots, Water pollution sources, Paving, Water quality, Rainfall-runoff relationships, Ammonium, Metals, Subsurface runoff, Streams, Conductivity, Water temperature, Surburban malls, New York.

Rainfall, surface runoff, and subsurface drainage plus streamflow upstream and downstream of a suburban New York mall parking lot were intensively sampled during and after a thunderstorm on June 18, 1978. Prior to the 11.4 mm which fell within less than 1.5 hours, no rain had fallen for 4 days. Ammonia-N concentrations were high (up to 2.5 mg per liter) in parking lot runoff, a result of precipitation which contained up to 2.0 mg per liter ammonia-N. Surface runoff had a peak in conductivity during the rainfall and returned to prestorm levels by the end of the study period. Initial runoff appeared gray and nearly opaque. Nine constituents (K, Mn, Fe, P, Pb, Zn, Mg, Ca, and Na) showed a peak in surface runoff between 45 and 60 min after the rain started, declined to a low at 75 min, and returned to prestorm values by 105 min. Drainage from subsurface drains was brown in color and had a strong odor. In the receiving stream, water temperature increased and conductivity decreased during the beginning of the storm and returned to prestorm levels after 5 hours. (Cassar-FRC)
W82-04252

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT. II. HEAVY METALS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, A. A. Ezzat, O. A. El-Rayis, and H. Hafez.
Water, Air and Soil Pollution, Vol 16, No 4, p 401-407, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Heavy metals, *Lakes, Zinc, Copper, Manganese, Iron, Cadmium, *Distribution patterns, Water pollution sources, *Lake Mariut, *Egypt, Industrial wastes, Fish.

This study deals with the occurrence and seasonal distribution of heavy metals in the water and Tilapia fish of Lake Mariut. Six stations were chosen to represent different regions in Lake Mariut. Two additional stations were selected at the connections of Umum Drain and Qala Drain with the lake. The mean concentrations of zinc, copper, iron, manganese, and calcium in the lake water were 10.9, 4.2, 19.1, 26.2, and 0.62 micrograms/liter, respectively. The monthly average values of zinc varied from a minimum of 3.4 micrograms/liter in October 1978 to a maximum of 20.5 micrograms/ liter in May 1979. The metal concentrations in the fish gave higher values for the liver than the stomach concerning zinc, copper, iron, and cadmium. The mean concentrations of zinc, copper, iron, and manganese found in the stomach were markedly higher than those present in the edible flesh of the flank region and the caudal peduncle. (Baker-FRC)
W82-04290

BIOGENIC AND ABIOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS IN SEDIMENTS FROM TWO REMOTE ADIRONDACK LAKES,
Department of Energy, New York. Environmental Measurements Lab.
Y. L. Tan, and M. Heit.
Geochimica et Cosmochimica Acta, Vol 45, No 11, 9 Fig, 7 Tab, 39 Ref.

Descriptors: *Aromatic compounds, *Lakes, *Sediments, Polynuclear aromatic hydrocarbons, Hydrocarbons, *Sagamore Lake, *Woods Lake, *New York, Perylene, Lake sediments, Organic matter, Abietic acid, Retene, Terpenes, Organic compounds, Water pollution sources, Fate of pollutants.

Polynuclear aromatic hydrocarbons (PAH) were determined in sediment cores from Sagamore Lake and Woods Lake, New York, remote from industrial activities. The composition and distribution of the parental PAH in the sediment indicate that the source of PAH in the surface is anthropogenic combustion of fossil fuels. Forest fires were ruled out as a source because sediment cores revealed no trace of the only known fire, which occurred about 80 years ago. All parental PAH, with the exception of perylene, decreased in concentration with depth in the cores. Perylene levels increased dramatically with depth to a maximum at 35 cm and decreased at greater depths. It has been suggested that perylene is transformed from natural precursors in the reducing environment, but the identity of these precursors was not investigated in this study. Concentrations of nonparental PAH were relatively uniform throughout the sediment cores. Some of the products identified were retene and other intermediates in the conversion of abietic acid to retene and hydrochrysenes and hydropicenes derived from pentacyclic triterpenes. Abietic acid is a major component of pine resins, and the pentacyclic triterpenes are widely distributed in higher plants. Concentrations of all parental PAH, except perylene, were higher in Woods than in Sagamore. The sediment densities and sedimentation rates are higher in Sagamore. (Cassar-FRC)
W82-04293

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,
Brookhaven National Lab., Upton, NY.
L. S. Evans, G. R. Hendrey, G. J. Stensland, D. W. Johnson, and A. J. Francis.
Water, Air, and Soil Pollution, Vol 16, No 4, p 469-509, 1981. 3 Fig, 3 Tab, 83 Ref.

Descriptors: *Water quality, *Acid rain, Rainfall, Air pollution, Acidic water, Hydrogen, Fish, Water pollution sources, *Water pollution effects, Ecological effects.

This paper discusses the relationship between precipitation acidity and receptor effects. First, the existence of acidic precipitation is documented, including temporal and spatial variability. A review of receptor characteristics is presented, along with responses to acidic precipitation, describing links between acidic precipitation and enviornmental effects where wuch links are known. Information gaps are highlighted. Finally the possibility of establishing a critical threshold for precipitation acidity is evaluated, which can serve as a meaningful standard to protect to protect terrestrial and/or aquatic biota. The chief anions accounting for the acidity in rainfall are nitrate and sulfate. Greater nutritional benefits are derived from acid rain by agricultural rather than forest systems, when considering soils alone. Acid deposition has caused acidification of fresh waters of southern Scandinavia, southwestern Scotland, southeastern Canada, and northeastern United States. Biological effects of acidification of fresh waters are detectable below a pH of 6.0. As lake and stream pH levels decreased below pH 6.0, many species of plants, invertebrates, and vertebrates were progressively eliminated. Current research inducates that establishing a maximum permissible value for the volume weighted annual hydrogen ion concentration of precipitation at 25 microeq/liter may protect the most sensitive areas from permanent lake acidification. (Baker-FRC)
W82-04302

A PRELIMINARY POLLUTION SURVEY OF THE PAPENKUILS RIVER, PORT ELIZABETH,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and W. D. Emmerson.
Water SA, Vol 7, No 4, p 211-215, October, 1981. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Heavy metals, *Water quality, *Water pollution sources, Path of pollutants, Coliforms, Metals, Sediments, Rivers, *Papenkuils River, Port Elizabeth, *South Africa, Nutrients.

Water samples from 20 sites along the course of the Papenkuils River, Port Elizabeth, South Africa, were analyzed for nutrients (ammonia, nitrite, nitrate, phosphate, and total phosphorus), Escherichia coli, and heavy metals. One identified pollution source was the Fishwater Flats sewage works. Many other unknown industries contributed wastes along the entire length of the river (formerly known as Smelly Creek), causing high metal concentrations in water and sediments and an absence of invertebrate fauns. Fecal coliforms were high near the sewage plant discharge and near a stormwater drain. Highest metal levels in water samples were (in micrograms per liter): Cu, 67, Pb, 326, Zn, 3600, Mn, 650; Ni, 106; Cd, 0.88; Cr, 83; and Hg, 1.047. Highest metal levels in sediments were (in micrograms per g): Cu, 740; Pb, 2400; Zn, 22,400; 465; Co, 6.0; Ni, 96; Cd, 15; Cr, 40,000; and Hg, 2. (Cassar-FRC)
W82-04346

ENGINEERING IN CATFISH PRODUCTION,
For primary bibliographic entry see Field 8I.
W82-04367

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-04377

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,
RAMLIT Associates, Berkeley, CA.
Y. J. Litwin, J. A. Lager, and W. G. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107947, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-223, October 1981. 3 p, 1 Fig. R-806357.

Descriptors: *Storm runoff, *Computer models, *Storm water, *Water pollution, Simulation, Planning, Land use, Water quality, Rainfall-runoff relationships, Nonpoint pollution sources, Wastewater treatment.

A simplified, continuous, stormwater management model (ABMAC) and user's manual were developed to provide an inexpensive, flexible tool for preliminary assessment of stormwater management strategy over large developed and undeveloped areas. The model, intended for use by local engineers and planners, is adaptable for mini-computer applications. The model is designed to simulate runoff, water quality, storage, and treatment while incorporating time and probability into the analysis. It allows for substantial flexibility in terms of input data requirements and output formats. All simulated quantities vary on a daily basis. The model can simulate nonpoint source pollution from a maximum of six land use categories. Six quality constituents are simulated including one user specified constituent. The application and testing of the model in the San Francisco Bay area, from 1976 to 1978, and 1978 to 1980, indicated satisfactory agreement between recorded and simulated records (within 40%). The model can be used effectively in conjunction with more sophisticated models of stromwater runoff and receiving waters. In such applications, ABMAC looks at broad areas and long periods, whereas the more sophisticated models can be best applied to selected, relatively small watersheds. (Moore-SRC)
W82-04393

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,
BDM Corp., Albuquerque, NM.
For primary bibliographic entry see Field 5A.
W82-04403

PARASITES IN SOUTHERN SLUDGES AND DISINFECTION BY STANDARD SLUDGE TREATMENT,

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Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
R. S. Reimers, M. D. Little, A. J. Englande, D. B. Leftwich, and D. D. Bowman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102344, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-166, October, 1981. 7 p, 2 Fig, 7 Tab. 805107

Descriptors: *Parasites, *Disinfection, *Sludge, *Protozoa, *Wastewater treatment, Heat, Eggs, Helminths, Lime, Ultrasonics, Seasonal variation, Pathogens, Temperature effects.

Sludge samples collected during each of the four seasons from 27 municipal wastewater plants located in Alabama, Florida, Mississippi, Louisiana, and Texas were examined for thee presence and densities of resistant stages of human and animal parasites. Viable eggs of Ascaris and Toxocara were recovered at least once from every plant and viable eggs of Trichuris vulpis and Trichuris trichiura were recovered at least once from 26 and 15 plants, respectively. Viable eggs of at least 10 other helminths and cysts of a few protozoa were also found in fewer numbers and less frequently. Depending upon the parasite, the inactivation of parasites during sewage treatment fluctuated from season to season, but, in general, most were inactivated in the summer. Laboratory studies verified that destruction of resistant parasite eggs is primarily due to temperature (heat) and not to a speciic digestion process. Very large lime doses were required for the inactivation of viable Ascaris in sludges and results were not always consistent. Laboratory experiments also showed that at certain combinations of ultrasonic frequency intensity and exposure time, Toxocara eggs could be destroyed, but that the same ultrasonic conditions did not affect Ascaris eggs. An important finding of this study is the poor suitability of Ascaris eggs taken from the uteri of gravid female worms as indicators of the characteristics of Ascaris eggs discharged in the feces of the host. (Moore-SRC)
W82-04408

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,
Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
H. K. Speidel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211425, Price codes: A02 in paper copy, A01 in microfiche. Report, June, 1981. 13 p. OWRT A-096-ARIZ(1). 14-34-0001-0103.

Descriptors: *Water pollution, *Coliforms, *Bacteria, *Pollutant identification, *Fecal streptococcus, Indicator bacteria, Speciation techniques, Bacterial survival.

Procedures proposed by the U.S. Environmental Protection Agency for the verification and speciation of fecal streptococci were evaluated using 9 standard cultures of streptococci obtained from the American Type Culture Collection (ATCC). The verification portion of the procedure was found to be very useful for the standard cultures as well as environmental isolates. The speciation method was not able to successfully speciate 67% of the standard cultures. The major problems which arose in the use of the speciation scheme included: carbohydrate fermentation reactions, hemolytic reactions, telurite reduction and excessive time and media requirements. A new scheme was developed to speciate the fecal streptococci. Thisnew procedure was based upon differences in the fermentation of six carbohydrates. The new procedure utilizes carbohydrate discs placed on Phenol Red Agar and takes only 24 hours after the verification of the fecal streptococcus isolate. Fecal streptococcal cultures were obtained from a variety of warm-blooded animals from the Northern Arizona Region. The cultures were speciated using the new procedure as well as the EPA procedure. The survival of fecal streptococci in an aquatic system was examined by placing the standard cultures into lake water held at 15 C. Samples were taken at 48 hour intervals and viable counts were made. The survival curves obtained classified the organisms into short term, medium term and long term survivors. The data also indicate that the currently used fecal coliform to fecal streptococcus ratio may not be valid especially after 12 hours from the time the organisms enter the water.
W82-04416

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,
Maine Univ. at Orono. Land and Water Resources Center.
S. A. Norton, R. B. Davis, D. F. Brakke, D. W. Hanson, and K. H. Kenlan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211434, Price codes: A06 in paper copy, A01 in microfiche. Report, July, 1981. 90 p, 50 Fig, 6 Tab, 50 Ref, 2 Append. OWRT A-048-ME(1).

Descriptors: *Acid rain, Acidic water, Diatoms, Plankton, *Heavy metals, *Water pollution sources, Cations, Lake sediments, *Lakes, *New England, *Ecological effects.

Ninety-four low-humic lakes in northern New England (82 in Maine) located in largely noncalcareous terrain were studied to detect possible changes in pH and associated effects. Modern colorimetric and electrode pH measurements yield equivalent results plus or minus 0.1 pH unit, permitting comparison of modern electrode pH measurements with older colorimetric measurements. Eight-five percent of the lakes are more acidic now. Studies of present water chemistry indicate that Fe, Mn, Pb, Zn, and Al concentrations tend to be higher with decreasing pH for the set of lakes; Na, K, Ca, Mg, and alkalinity tend to be higher with increasing pH for the set of lakes. Surface sediment chemistry indicates that (at the 95% significance level) the concentrations of Na2O, K2O, MgO, and organics are highest at higher lake pH values; Cu increases with decreasing pH. CaO, FeO, MnO, A12O3, TiO2, Pb, and Zn concentrations do not relate to pH. The relative abundances of taxa of diatom remains in profundal surface sediments from a sub-set of 25 lakes are related to surface water pH's in the range of 4.4 to 7.0. In a cluster analysis, the diatom assemblages from lakes with pH less than 5.7 separate from those with pH greater than 5.8. Greatest taxonomic diversity occurs at pH 5.8. Some unknown factor associated with lake altitude (52 - 1009 m) accounts for scatter in the pH-diatom relationship. In studies of cladoceran associations in profundal surface sediments from 18 of the lakes with a pH range of 4.4 to 6.9, it was not possible to uncouple the effects of pH and altitude (78 - 1123 m). Cladoceran stratigraphy in sediment cores from three high-altitude lakes indicates community changes concurrent with changes in diatom assemblages postulated to be caused by lake acidification.
W82-04420

ESTIMATION OF ACCUMULATION PARAMETERS FOR URBAN RUNOFF QUALITY MODELING,
Geological Survey, Reston, VA.
W. M. Alley, and P. E. Smith.
Water Resources Research, Vol 17, No 6, p 1657-1664, December, 1981. 5 fig, 2 tab, 13 Ref.

Descriptors: *Urban runoff, *Accumulation, *Water quality, *Model studies, Pollutant load, Water pollution sources, Washoff, Fate of pollutants, Runoff, Sensitivity analysis, Paving.

Watershed models use accumulation and washoff equations to simulate the quality of runoff from urban impervious areas. This paper explores methods of estimating accumulation parameters and analyzes the sensitivity of model output to changes in these parameter values. Parameters evaluated are the maximum amount of constituent on effective impervious areas (in kg); the rate constant for constituent removal (per day); and the washoff coefficient (per mm). An equation is given which accounts for observations that the rate of pollutant accumulation is largest for a few days after a rainfall or street cleaning and eventually approaches zero because constituents are resuspended by wind or vehicular traffic. This curve is more general than the linear accumulation curves used in most models. An exponential equation for constituent washoff developed in a previous paper is presented. Results of applying these techniques and sensitivity analysis show that the shape and magnitude of the constituent accumulation curves should be better defined. The amount of residual material remaining on the streets after storms and cleaning must also be considered. (Cassar-FRC)
W82-04432

A FINITE ELEMENT MODEL FOR THE MIGRATION OF LEACHATE FROM A SANITARY LANDFILL IN LONG ISLAND, NEW YORK - PART I: THEORY,
Argonne National Lab., IL.
A. B. Gureghian, D. S. Ward, and R. W. Cleary.
Water Resources Bulletin, Vol 16, No 5, p 900-906, October, 1980. 3 fig, 1 Tab, 31 Ref.

Descriptors: *Leachates, *Model studies, Simulation, Computers, Infiltration, Percolation, Leaching, Soil solution, *Landfills, Sanitary landfills, Waste dumps, Mathematical studies, *Long Island, New York.

This work illustrates the development and accuracy of a two dimensional finite element mathematical model for the migration of ground water contamination. For obtaining a solution to the mass transport equation by means of quadrilateral elements with linear sides, the Upstream (Upwind) FEM seems to be a better choice than the Galerkin FEM to avoid overshoot and oscillations in applying the model to field problems. Due to the fact that the weighting functions are dependent on the cell Courant number, the computational cost will increase slightly if the value of this parameter is other than constant in the progress of the solution. The optimal weighting parameters in the transient simulation need to be precisely defined for grid networks with variable mesh spacing. A field application of the model to the leachate migration from the Babylon sanitary landfill in Long Island, New York, has been carried out. (Baker-FRC)
W82-04434

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W82-04437

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
D. J. Horvath, and R. A. Koshut.
Journal of Environmental Quality, Vol 10, No 4, p 491-497, October/December, 1981. 7 Tab, 30 Ref. A-025-WVA(2).

Descriptors: *Sludge, *Effluents, *Heavy metals, *Wastewater treatment, Metals, Land disposal, Water pollution sources, Cadmium, Zinc, Lead, Nickel, Manganese, Iron, Chromium, Potassium, Magnesium, Phosphorus, Nitrogen, Calcium, Copper, *Municipal wastewater, *West Virginia.

The distribution of 13 elements between sludges and effluents from 11 West Virginia municipal sewage treatment plants was determined from analytical results and the discharge rates. It was obvious that municipalities vary appreciably in their ability to remove elements from wastewater and that the elements vary in behavior. The % of element in effluent followed by % in sludge were Ca, Mg, and K, 82-99, 1-18; Cd, 35-98, 2-65; Cr, 12-86, 9-88; Cu, 15-99, 1-85; Fe, 9-88, 12-91; Mn, 18-81, 19-82; Ni, 30-97, 3-70; Pb, 42-85, 15-58; Zn, 33-84, 16-67; P, 56-96, 4-44; and N, 57-98, 2-43. Ratios of Zn:Cd were 97:1 in influents, 150:1 in sludges, and 30:1 in effluents. Zn:Cu ratios remained about

6:1 through the entire process. This points out cadmium's greater mobility (and the greater environmental threat to water and soil). (Cassar-FRC)
W82-04465

POSSIBLE WATERBORNE TRANSMISSION AND MAINTENANCE OF INFLUENZA VIRUSES IN DOMESTIC DUCKS,
Hong Kong Univ. Dept. of Microbiology.
D. D. Markwell, and K. R. Shortridge.
Applied and Environmental Microbiology, Vol 43, No 1, p 101-116, 1982. 1 Fig, 5 Tab, 25 Ref.

Descriptors: *Water supply, *Diseases, *Contamination, *Ducks, Ponds, Potable water, Public health, *Viruses, Infection, *Influenza, Path of pollutants, Epidemics, Epizootiology, Hong Kong.

The ecology of avian influenza viruses was examined on two duck farms in the Hong Kong area. Monthly examinations were made for a period of 1 year. In one community the predominant virus was H3N2, which is antigenically related to the pandemic Hong Kong strain. The virus was isolated each month from either the feces or the pond water, or both, which suggests a pathway of waterborne transmission. The viruses demonstrated persistence in the community in that 1 and 2 years after the last sampling date viruses of the same antigenic combination were isolated. Infection was asymptomatic. The virus appeared to be dependent on the continual introduction of ducklings susceptible to infection onto virus contaminated water. Ducks 70 to 80 days old were generally free of detectable virus in spite of exposure to virus in pond water. The normal practice of raising ducks of different ages on the same farm and having them share a common water supply seems significant in the large reservoir of influenza viruses in the duck population of southern China. It is conceivable that virus transmission could occur in this manner to other susceptible animals, including humans. (Baker-FRC)
W82-04468

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,
Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
For primary bibliographic entry see Field 5D.
W82-04477

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,
Thames Water Authority, London (England).
M. L. Richardson, and A. Waggott.
Ecotoxicology and Environmental Safety, Vol 5, No 4, p 424-436, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Dyes, *Degradation, Fate of pollutants, *Pollutant identification, Acid Blue 1, Water analysis, Wastewater analysis, Chlorination, Adsorption, Spectrophotometry, Chromatography.

The presence of the triphenylmethane dye, Acid Blue 1 (Chemical Abstracts Services Registry Number 129-17-9) was determined in the aquatic environment by adsorption of XAD-2 ion exchange resin, elution, and spectrophotometric measurement as well as by high performance liquid chromatography. Concentrations of the dye (in micrograms per liter) were 0.6-1.7 in river and reservoir water, 9.2-12.3 in sewage effluent, and less than 0.4 in finished water. Distilled water and tap water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with 1 mg per liter chlorine for 10, 15 or 30 minutes. Dye was destroyed in all but one case; tap water with a 10 microgram per liter concentration of dye exposed for 10 minutes contained 0.6 micrograms per liter residual dye. Exposure of 4 mg per liter dye in distilled water to 15 hours of continuous simulated sunlight did not measurably reduce the dye concentration. (Cassar-FRC)
W82-04478

ACCUMULATION AND DEPURATION OF METALS BY DUCKWEED (LEMNA PERPUSILLA),
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. R. Clark, J. H. VanHassel, R. B. Nicholson, D. S. Cherry, and J. Cairns, Jr.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 87-96, 1981. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Bioaccumulation, Fate of pollutants, Metals, Cadmium, Copper, Iron, Manganese, Zinc, Chromium, Lead, Nickel, *Duckweed, Macrophytes, Detention reservoirs, Ash, Powerplants.

Duckweed (Lemna perpusilla) accumulated metals (Cd, Cu, Fe, Mn, Zn, Cr, Pb, and Ni) both in a heavy coal ash secondary retaining basin and under controlled laboratory conditions simulating metal concentrations 0.5, 1, 10, 25, and 100 times the levels of metals found in the retaining basin water. Duckweed in the outdoor basin accumulated Cr, Pb, and Ni to a slightly higher extent and Cd, Cu, Fe, Mn, and Zn to a much greater extent than found in sediments. Levels of metals in the basin water were lower than duckweed and sediment concentrations. During a 14-day depuration period concentrations of Pb, Cr, and Ni declined to sediment levels, Cu and Cd levels approached sediment levels, and Zn, Mn, and Fe levels remained considerably higher. During the 10-day laboratory exposures Pb and Cr bioaccumulation was significantly greater than control at levels of 10 times or greater, and Ni accumulation was significant at the 1 x level and above. Duckweed populations showed high mortality at concentrations 10 x and higher. After 8 days depuration the metal concentrations in duckweed were reduced to control levels. Cu and Cd showed high increases in bioconcentration at the 0.5 and 1 x concentrations and were not eliminated during the depuration period. Duckweed accumulated Zn and Mn at the 1 x exposure and above but did not show depuration. Duckweed's capacity to concentrate metals may result in minimal concentrations of these metals in water during the growing season and sudden releases upon natural die-off in the fall, causing unusually high levels of metals at that time. (Cassar-FRC)
W82-04479

A HYDROLOGIC SIMULATION FOR PREDICTING NONPOINT SOURCE POLLUTION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
K. G. Eggert.
PhD Thesis, 1980. 431 p, 41 Fig, 21 Tab, 117 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-10802.

Descriptors: *Hydrologic models, *Water pollution sources, *Watershed management, *Nonpoint pollution sources, Prediction, Mathematical models, Flow channels.

A hydrologic model for use in predicting nonpoint source pollution is developed. The model is a mathematical representation of watershed hydrology and hydraulics. It is formulated to investigate watershed response to management activity. The model simulates water balance on a daily basis by incorporating the processes of evapotranspiration and soil water redistribution resulting from meteorological variations. Surface water runoff is calculated using the kinematic wave approximation for overland and channel flows. The multiple watershed routing component allows large drainage basins to be addressed. Analytic techniques are used for overland flow routing and primary channels, while a numerical solution is used in the main channel segments. Sediment is routed by size fraction using the Meyer-Peter, Muller equation for bedload, and suspended sediment is calculated. Application for validation of individual components is presented. Examples of management alternative impact on water and sediment yields from a hypothetical watershed are also presented. The alternatives examines include clearcut timber harvest by various techniques and the impact of wildland grazing methods. The model's strength are shown to be a flexible computation structure, a minimum of regionally specific code and a representation based on hydrologic and hydraulic processes. The physically based mode allows management alternative changes to be reflected in physically predictable parameters. The model is formulated in such a manner that it may be used to drive other nonpoint source models as required by a specific problem. (Sinha-OEIS)
W82-04485

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04504

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04515

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
J. W. Mercer, P. Davis, K. F. Dennehy, and C. L. Goetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153610, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-36, May, 1981. 92 p, 20 Fig, 5 Tab, 5 Ref.

Descriptors: *Radioactive waste disposal, *Geohydrology, *Test wells, *Hydrologic data, Groundwater movement, Transmissivity, Storage coefficient, Testing procedures, Water sampling, Water analysis, *New Mexico, Eddy County, Waste Isolation Pilot Plant.

Data were collected during hydrologic testing at wells H-4A, H-4B, and H-4C in the southern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested, the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact, yield water to wells at rates less than 0.9 gallon per minute. Throughout the testing, water-pressure response in the tested zone was monitored by a pressure transducer system. Shut-in and slug tests were conducted to acquire the data from which the following values were derived. Calculated transmissivities for the Magenta, Culebra and the Rustler-Salado contact at wells H-4A, H-4B, and H-4C were 0.06, 0.9, and 0.0006 foot squared per day respectively. Water samples from the Magenta and Culebra had dissolved-solids concentrations of 22,300 and 18,100 milligrams per liter, respectively. The major chemical constituents of ground-water samples from these two zones were sodium, chloride, and sulfate. Water samples from the Rustler-Salado contact had a dissolved-solids concentration of 322,000 milligrams per liter and magnesium, sodium, and chloride were the major constituents. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones. (USGS)
W82-04517

SURVEY OF SELECTED ORGANIC COMPOUNDS IN AQUIFERS OF NEW YORK STATE EXCLUDING LONG ISLAND,
Geological Survey, Albany, NY. Water Resources Div.
R. A. Schroeder, and D. S. Snavely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-139957, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-47, 1981. 60 p, 1 Fig, 8 Tables, 41 Ref.

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Descriptors: *Organic compounds, *Groundwater, *Aquifers, *Water pollution sources, Organic wastes, Contamination, Wells, Sampling, Water analysis, *New York.

Samples from 56 wells at 49 sites in New York State, excluding Long Island, were analyzed by gas chromatography/mass spectrometry for the presence of organic compounds designated 'priority pollutants' by the U.S. Environmental Protection Agency. Most samples were taken from public-supply wells tapping shallow, permeable aquifers, the most susceptible to contamination. Analytical sensitivity reported by the laboratory for most compounds was less than 1 microgram per liter, but contamination during collection, shipping, or laboratory processing required that concentrations be about 10 micrograms per liter before the presence of a compound could be confirmed. Only a small percentage of wells sampled in this study was found to be contaminated. Where contamination is present, it probably results from point sources such as landfills or dumps rather than from general sources such as atmospheric deposition or proximity to urban centers. Two sites, Brewster in Putnam County and Olean in Cattaraugus County, showed clear evidence of contamination. Two other sites, Corning in Steuben County and Fulton in Oswego County, showed evidence of possible contamination. (USGS)
W82-04520

A CORRELATION STUDY OF BIODEGRADABILITY DETERMINATIONS WITH VARIOUS CHEMICALS IN VARIOUS TESTS II. ADDITIONAL RESULTS AND CONCLUSIONS,
Henkel KGaA, Dusseldorf (Germany, F.R.).
P. Gerike, and W. K. Fischer.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 45-55, 1981. 3 Tab, 20 Ref.

Descriptors: *Biodegradation, *Organic compounds, *Toxicity, Activated sludge process, Biological treatment, Wastewater treatment, Degradation, *Fate of pollutants, Water pollution effects.

This paper reports work previously started on biodegradability of 44 compounds by 7 tests (the modification of the OECD Confirmatory Test for the application of the carbon analysis, the Zahn-Wellens, the Japanese MITI, the French AFNOR T 90-302, the Sturm, the Modified OECD Screening, and the Closed Bottle Test according to Fischer). This work added two more tests, the U.S. EPA Activated Sludge Test and a model trickling filter. The following conclusions were based on previous and present work. The AFNOR T 90-302 42-day test is a powerful test for noninhibitory compounds and may exaggerate degradation in some cases, e.g., sulfanilic acid. It is overly sensitive toward inhibitory or toxic materials. The EPA activated sludge test strongly exaggerated the predictive value of biodegradability results for the general environment. Environmentally relevant positive results were obtained from the Closed Bottle Tests, the Modified OECD Screening Test, and the MITI Test. The authors feel that special preacclimation procedures should be excluded in the first step of biodegradability testing and that the test duration be limited to 4 weeks. A group of tests was designated appropriate for fail-safe tests of ready biodegradability with the limits 60% dissolved organic carbon removal or 50% BODT or CO2 production. These were the Japanese MITI test, the French AFNOR T 90-302 Test restricted to 4 weeks, the Sturm Test without the preacclimatization step, the Modified OECD Screening Test extended to 4 weeks, and the Closed Bottle Test according to Fischer. (Cassar-FRC)
W82-04534

ROLE OF NATURAL COLLOIDS IN THE TRANSPORT OF HYDROPHOBIC FOLLUTANTS,
Maryland Univ., College Park. Center for Environmental and Estuarine Studies.
J. C. Means, and R. Wijayaratne.
Science, Vol 215, No 4535, p 968-970, February 19, 1982. 2 Fig, 1 Tab, 12 Footnotes.

Descriptors: *Herbicides, *Adsorption, *Colloids, *Fate of pollutants, Atrazine, Linuron, Estuarine environment, Sorption, Organic matter, Salinity, Hydrogen ion concentration, Chesapeake Bay, *Choptank River, *Patuxent River.

Linear Freundlich adsorption coefficients for the herbicides atrazine and linuron were 1850 and 6750, respectively, in a study of waters containing natural estuarine colloids. Water samples collected from the Choptank and Patuxent Rivers near Chesapeake Bay were filtered to enrich the colloidal fraction. Salinities ranged from 1 to 19 o/oo, and carbon contents of the enriched colloidal fractions from 33.5 to 108.5 mg per liter. The herbicide-colloid-water mixtures were equilibrated in a shaker for 18 hours at 20 C. The sorption constants of atrazine decreased from 2200 to 1800 with a salinity increase from 8 to 16 o/oo. Linuron and atrazine showed sorption peaks at pH 8.0. Significant decreases in sorption were observed as pH decreased to 5.0 or increased to 9.0. The high adsorption coefficients suggest that natural colloids may be important in transporting hydrophobic pollutants in the aquatic environment. (Cassar-FRC)
W82-04539

ACID SNOW IN THE CANADIAN HIGH ARCTIC,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
For primary bibliographic entry see Field 2C.
W82-04542

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),
Munich Univ. (Germany, F.R.). Geographisches Inst.
G. Michler, C. Steinberg, and P. Schramel.
Wasserwirtschaft, Vol 71, No 11, p 323-330, 1981. 4 Fig, 3 Tab, 27 Ref. English Summary.

Descriptors: *Heavy metals, *Lakes, *Sediments, *Bavaria, Germany, Cores, Dating, Limnology, Path of pollutants, History, Isar River, Diversion, Catchment areas, Municipal wastes.

Typical examples of results obtained to date in a study of the heavy metal contents in sediment cores from 18 South Bavarian lakes are presented. The Ammersee core was studied for vertical distribution of heavy metals. The heavy metal contents in the lower layer were taken as the geological background. The heavy metal contents generally increased at an accelerating rate, over time, with some irregularities which could be correlated with historical events and with a decrease in the last 10-20 years corresponding to decreased coal burning. According to the geoaccumulation index, the Ammersee is classified as moderately to heavily loaded with cadmium, heavily loaded with zinc, and scarcely loaded with copper, lead and chromium. The Walchensee illustrates the effects of water use projects on heavy metal levels. Part of the upper Isar and Rissbach flows were diverted into the Walchensee in 1924 and 1949 to provide increased flows for a hydroelectric plant, increasing the catchment area of the Walchensee from 74 sq km to 770 sq km. The metal components could be divided into two groups: those which are deposited at practically constant rates in the absence of increased sedimentation due to water projects, and those whose levels increased continuously even after the construction erosion ended. Copper accumulation is showing a continuous increase accompanying introduction of treated wastewaters into the Isar. The Speichersee is an artificial lake, receiving large volumes of wastewater, from Munich. Even considering its function as a 'heavy metal trap' the concentrations found were alarming. Lead concentrations exceeding 2000 ppm and cadmium concentrations exceeding 100 ppm were found. (Carroll-FRC)
W82-04550

DEVELOPMENT OF IMPROVED STORMWATER QUALITY MODELS,
Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, and D. D. Adrian.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No 5, p 957-974, October, 1981. 6 Tab, 16 Ref. OWRT A-095-MASS, B-059-MASS.

Descriptors: *Urban hydrology, *Storm water, *Water quality, Rainfall-runoff relationships, Model studies, Water pollution sources, *Fate of pollutants, Runoff, *Urban runoff.

A method for developing urban storm water pollutant washoff models has been outlined for the purpose of improving reliability of results. The procedure consists of testing several linear and linear transform multiple regression models for estimating pollutant washoff loadings as a function of storm and basin characteristics using measured data. Then the best model can be chosen for each pollutant using the coefficient of determination and othe criteria. Although estimates of buildup and washoff are eliminated, it is still necessary to gather storm event data for each basin to be modeled. The method is illustrated using data from Seattle, Washington, to predict storm event total loadings for long-term simulation purposes. Calculated results were as follows: suspended solids and COD, within the range of reported values; ammonia, slightly less than reported values. (Cassar-FRC)
W82-04559

NEARFIELD PERFORMANCE OF RIVER DIFFUSERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr, and J. G. Melville.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 995-1008, October, 1981. 9 Fig, 1 Tab, 10 Ref. OWRT A-077-ALA.

Descriptors: *Diffusers, *Thermal pollution, *Mixing, Rivers, Model studies, Mathematical models, Mississippi River, Powerplants, Heated water, Thermal water, Fate of pollutants, Temperature, Water temperature, Flow characteristics.

A model was developed to describe the flow field induced by a submerged multiport diffuser discharging in a rectangular channel. Nearfield dilution was determined as a function of effluent and ambient flow parameters. A family of curves is given for a range of conditions characteristic of prototype river diffusers (centered and shore-attached). Comparisons of model predictions with data observed in the Mississippi River downstream from the Quad Cities Nuclear Power Station diffuser were generally in agreement. However, the depth-averaged minimum dilution was underpredicted by about 7%, probably as a result of neglecting lateral entrainment. (Cassar-FRC)
W82-04561

ORGANIC CARBON FLOW IN A SWAMP-STREAM ECOSYSTEM,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. J. Mulholland.
Ecological Monographs, Vol 51, No 3, p 307-322, September, 1981. 9 Fig, 6 Tab, 72 Ref. OWRT B-084-NC, B-110-NC.

Descriptors: *Organic carbon, *Litter, *Streams, *Swamps, *Organic loading, *North Carolina, Total organic carbon, Carbon, Decomposing organic matter, Organic matter, Respiration, Detritus, Dissolved solids, Ecosystems, Oxidation, Watersheds, Wetlands, Productivity.

An annual organic carbon budget for a section of Creeping Swamp, North Carolina is presented. Most of the input was allochthonous, with high autochthonous organic carbon input from filamentous algae during February and March. The output of organic carbon by fluvial processes was 36% of total annual inputs, indicating that the swamp section studied was 64% efficient at retaining organic

carbon. Most organic carbon was retained by respiration. Indices of organic matter processing and a loading potential index were used to compare organic carbon dynamics in the Creeping Swamp segment to that of upland stream segments. The organic carbon loading potential of the swamp was greater than that of the comparison streams, due to its great width and complete canopy. The dense vegetation and low gradient of the swamp increase organic carbon retention by maintaining low water velocities with little erosive force, tortuous flow paths and debris dams. Retention and oxidation of organic carbon in the flooded Creeping Swamp ecosystem occurs in the floodplain. A net annual export of organic carbon in the dissolved form is attributed to the extensive drainage network of the swamp stream system. (Geiger-FRC)
W82-04564

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and A. Troth.
Water Research, Vol 16, No 1, p 105-112, January, 1982. 9 Tab, 26 Ref.

Descriptors: *Bacterial analysis, *Land use, *Lake shores, *Water pollution sources, Fate of pollutants, Water quality, Coliforms, Lakes, *Mississippi Lake, *Ontario, Heterotrophic bacteria, Swimming, Eutrophic lakes, Recreation, Chlorophyll a, Diseases, Water pollution effects, Public health.

A bacterial analysis of water samples from Mississippi Lake, a shallow eutrophic lake in Ontario, indicated that the main sources of fecal coliforms were cattle watering sites, farms, public beaches, flooded and substandard septic tanks, and a bird sanctuary. Sampling was done May 28-June 6 and July 20-29, 1976, at 75 shoreline locations, 5 mid-lake stations and 5 lake bottom locations. Water quality impairment was localized near the suspected pollution sources. After a rain, levels of fecal coliforms and fecal streptococci increased 10-fold in the lake surface water. Bacterial counts returned to previous levels after 2-3 days. Aerobic heterotrophic bacterial counts at mid lake surface sites were 1600 per 100 ml in June and 8270 per ml in July. Average chlorophyll a concentrations were 2.0 micrograms per liter. A survey of cottage residents on the lake indicated that 57 of 67 reported infections were ear infections, which were experienced by3.28% of bathers. Ear infections were more common in the bathers who spent more time in the water. Young people had higher ear infection rates than adults. Suggestions to improve the water quality of this lake are: eliminate cattle watering sites from the lake shore, correct substandard septic tanks, and open more public beaches. (Cassar-FRC)
W82-04567

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,
National Swedish Environment Protection Board, Uppsala (Sweden).
For primary bibliographic entry see Field 2H.
W82-04586

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,
For primary bibliographic entry see Field 5A.
W82-04588

ATTENUATION OF POLYBROMINATED BIPHENYLS AND HEXACHLOROBENZENE BY EARTH MATERIALS,
Municipal Environmental Research Lab., Cincinnati, OH.
N. M. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107558, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/S2-81-191, December, 1981. 7 p, 2 Fig, 6 Tab. R-804684-01.

Descriptors: *Polybrominated biphenyls, *Hexachlorobenzene, *Leaching, *Solubility, *Land disposal, Waste disposal, Leachates, Microbial degradation, Pollutants, Adsorption, Soil contamination, Landfills, Water pollution sources.

This laboratory study of the aqueous solubility, adsorption, mobility, and microbial degradation of polybrominated biphenyls (PBB's) and hexachlorobenzene (HCB) was undertaken to provide information on their behavior in the environment, particularly on the potential for their movement through soil at land disposal facilities for hazardous wastes. PBB's were more than 200 times, and HCB more than 2.5 times more soluble in landfill leachate than in distilled water. Also the solubilities of PBB's and HCB were higher in creekwater and landfill leachates than in purified waters; this was correlated with the level of dissolved organics in the waters. HCB showed a greater tendency for adsorption on soils than did PBB's. There was a high direct correlation between the total organic carbon content of the soils and the amount adsorbed. PBB's and HCB were strongly adsorbed by carbonaceous Ambersorb XE-348 from organic solvents. PBB's and HCB remained immobile in earth materials when leached with water and DuPage leachate, but were highly mobile when leached with organic solvents. PBB's and HCB were found to be resistant to microbial degradation. It is recommended that disposal of PBB or HCB wastes dissolved in organic solvents, or co-disposal of PBB or HCB materials with organic solvents be avoided at land disposal sites unless a carbonaceous liner material is used. (Moore-SRC)
W82-04620

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,
Rockwell International, Newbury Park, CA.
For primary bibliographic entry see Field 5D.
W82-04625

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 4C.
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
N. P. Kobriger, T. L. Meinholz, M. K. Gupta, and R. W. Agnew.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-124911, Price codes: A10 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/044, February, 1981. 205 p, 25Fig, 36 Tab, 16 Ref, 8 Append. DOT-FH-11-8600.

Descriptors: *Mathematical models, *Computer models, Highways, *Runoff, *Water pollution sources, Storm runoff, *Highway effects, Environmental effects, Urban runoff, Rainfall-runoff relationships.

The purpose of the predictive procedure is to provide highway designers with a simplified tool to estimate the quantity and quality of storm generated highway runoff. The predictive procedure is comprised of a series of equations which can be computerized to form a mathematical model. The procedure is made up of four components correspondng to the following functions: rainfall runoff; pollutant buildup; pollutant wash-off; and constituent loadings. The predictive procedure can be used for Environmental Impact Statements or to determine the loadings for analysis of the pollutant discharge effect of various design storms at a particular site. The procedure can also be used to evaluate existing highway systems. Equations were developed relating runoff volume to rainfall volume for three highway site types: urban elevated bridge decks with 100% paved areas; urban paved and nonpaved drainage areas; and rural flush shouldered highways. Total solids showed the highest correlation with other monitored parameters and is therefore used as the carrier pollutant in the predictive procedure to estimate 16 other parameters. The wash-off coefficients developed for the three highway site types used in this study are: 5.0 for urban elevated bridge decks; 6.5 for urban paved and nonpaved drainage areas; and 12.0 for rural flush shouldered highways. (Moore-SRC)
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,
Envirex Inc., Milwaukee, WI.
N. P. Kobriger, and T. M. Krischan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241937, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/046, February, 1981. 125 p, 18 Fig, 18 Tab, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Computer programs, Snowmelt, Storm runoff, *Water quality, Hyetographs, Hydrographs, Rainfall-runoff relationships, Path of pollutants.

The Data Storage Program (DSP) was developed as part of a project to determine the characteristics of highway runoff. Due to the nature of the study, an extensive data collection and chemical analysis program was required and more than 14,000 pieces of data were generated. DSP was developed to: retain a large quantity of field generated data in an organized and easily accessible format; permit conversion of standard units to metric; and provide a mechanism by which the data can be recalled for optional plotting or statistical analysis. The data base developed during the project is perhaps the most extensive highway runoff quantity/quality data in existence. This data is available on magnetic tape with access provided by DSP. Highway runoff is highly variable in that it results primarily from precipitation or snowmelts and as such its description contains a rainfall hyetograph, a runoff hydrograph, water quality parameters, dustfall data, and various site characteristics. The program provides a readily available and convenient means for storage and analysis of environmental and operational data collected during future highway runoff studies. (Moore-SRC)
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,
Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, D. Gruber, and W. Kreutzberger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241929, Price codes: A08 in paper copy, A01 in microfiche. Federal Highway Administration Report FHWA/RD-81/045, February, 1981. 171 p, 43 Fig, 41 Tab, 27 Ref, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Storm runoff, *Highway effects, Environmental effects, Rainfall-runoff relationships, Nutrients, Heavy metals, Particulate matter, Oxygen demand, Coliforms, Oil pollution, Fate of pollutants.

From the Spring of 1976 to September 1977, a total of 159 storm events were monitored at six sites: three sites in Milwaukee, Wisconsin; one in Harrisburg, Pennsylvania; one in Nashville, Tennessee; and one in Denver, Colorado. The data were evaluated for: rainfall/runoff relationships; highway runoff pollutant loadings and variations with time; differences in pollutant characteristics from paved and non-paved areas; and correlation of pollutants among measured parameters as well as with highway operation related factors. The average runoff volume to rainfall volume coefficients for non-winter storm events were found to vary between 0.20 to 0.92. Most heavy metals were associated with the particulate matter in highway runoff. The average BOD5 values in highway runoff were found to be comparable with effluent from a well

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operated secondary municipal treatment plant. The nutrient loadings were generally comparable to urban stormwater runoff. Sizable concentrations of total coliforms, fecal coliforms, and fecal streptococci were found at all sites. The average oil and grease concentrations in monitored storm events ranged between 1 mg/l at the all-grassy site to 20 mg/l at the all-paved site. Generally, the all-paved site showed the highest loadings for various constituents. (Moore-SRC)
W82-04637

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),
Arago Lab., Banyuls-sur-Mer (France).
G. Cahet, P. Crassous, J. Neveux, and F. Rassoulzadegan.
Internale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 223-248, 1981. 12 Fig, 4 Tab, 38 Ref. English summary.

Descriptors: *Plankton, *Eutrophication, *Marine bacteria, Marine algal, Nutrients, Euphotic zone, Dissolved organic matter, Metabolism, *Carbohydrates, Phytoplankton.

Relationships between heterotrophic activity and phytoplankton excretion were studied in naturally and artificially eutrophicated systems. Excretion appears to have a greater significance in zones of low phytoplankton content than of high content. It increases in the presence of light and ammonium ion. Ion exchange resin analysis of the excreta indicated that the acid fraction generally dominates, while the neutral (glycid) fraction is more significant under dim light conditions. Two enrichment studies on eutrophic and oligotrophic marine waters. In the first case heterotrophy increases with algal biomass; in the second case a first heterotrophic optimum precedes the exponential growth phase of the algae and a second optimum follows. The findings aid in explaining the observed variations in degradation of organic matter depending on the phytoplankton composition. The metabolic adaptability of the bacterioplankton appears responsible for their ability to thrive in nutrient-poor water. In upwelling zones the bacterioplankton activity determines the chemical composition of the water. It also contributes to the maintenance of low dissolved organic carbon contents across large gradients of primary productivity in the photic zone. (Carroll-FRC)
W82-04672

DISPERSION COEFFICIENTS IN ESTUARIES,
Birmingham Univ. (England).
J. R. West, and T. W. Broyd.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 721-737, September, 1981. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Saline water intrusion, *Solute transport, *Mixing, *Dispersion coefficients, Tidal hydraulics, Fate of pollutants, *Estuaries, Tidal effects.

Published methods of predicting longitudinal dispersion coefficients for estuaries were compared using field data from five British estuaries, Mersey, Conwy, Tay, Usk, and Thames. Values of dispersion coefficients predicted by theoretically based expressions gave values within a factor of three of the gross field data values for mean tidal range and low river flow in all five estuaries. In the narrow, shallow estuaries the transverse oscillating shear mechanisms were dominant. Transverse gravitational shear mechanisms dominated in the wide estuaries. An empirical expression predicted tidal mixing within a factor of five of the field data values. The theoretical and empirical expressions can provide useful estimates of dispersion coefficients if carefully used. (Cassar-FRC)
W82-04684

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 4C.
W82-04690

SELECTED TRACE METALS IN THE UPPER ST. JOHNS RIVER AND THEIR LAND USE RELATIONSHIPS,
General Battery Corp., Reading, PA.
J. A. Leed, and T. V. Belanger.
Florida Scientist, Vol 44, No 3, p 136-150, 1981. 8 Fig, 5 Tab, 14 Ref.

Descriptors: *Rivers, *Trace metals, *St Johns River, Florida, Land use, Path of pollutants, Water pollution sources, Copper, Zinc, Iron, Environmental effects, Water analysis, Fish, Sediments.

In this study iron, copper and zinc were monitored in four species of fish, in the water and in sediments of the upper St. Johns River in order to evaluate land use-water quality relationships. The role of natural interacting processes was also investigated in regulating surface water trace metal concentrations, the accumulation of trace metals in bottom sediments and fish tissues, the relationships between fish weight or total length and trace metal levels in the muscle, gills, and liver, and the relationship between volatile solids (organic matter) and trace metal concentrations in the sediments. Total copper and zinc were present at low concentrations in the surface waters of the upper St. Johns River, but total iron frequently occurred at concentrations exceeding the state standard of 300 micrograms/liter. Levels of total iron appear to be regulated by resuspension of bottom sediments caused by increased discharge and resulting turbulence. Groundwater inputs may influence trace metal content, particularly of iron. The average surface water total iron was highest in the headwaters region of the river above Lake Helen Blazes, decreasing in a northward direction to Lake Washington, and increasing to Lake Poinsett. Higher levels of iron, copper and zinc were found in sediments containing higher percentages of organic matter. Analysis of these metals in the tissues of fish indicates that they are concentrated in the liver, with lower amounts in the gill and muscle tissue. Total copper and total zinc were highly correlated to land use associated with urban activities. (Baker-FRC)
W82-04718

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,
Battelle Pacific Northwest Labs., Richland, WA.
D. Rai, R. G. Strickert, D. A. Moore, and R. J. Serne.
Geochimica et Cosmochimica Acta, Vol 45, No 11, p 2257-2265, November, 1981. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Americium, *Solubility, *Radioactive waste disposal, Waste disposal, Fate of pollutants, Equilibrium, Hydrogen ion concentration, Minerals, Sorption, Chemical precipitation, Solute transport, *Groundwater pollution.

Solubility mechanisms of americium, a long-lived waste product of nuclear energy production, were studied to predict Am concentrations in groundwaters. Suspensions of sediments contaminated with acidic (pH 2.5) liquid radioactive wastes were equilibrated in 0.0015 M CaCl2 solutions adjusted with NaOH to pH of 4.35, 5.3, 6.8, and 7.72 for 100 days. The solubility-limited Am concentrations decreased 10-fold with one unit increase in pH. An equation is presented for predicting Am concentrations in solutions containing contaminated sediments from old waste disposal sites. It is not applicable to high carbonate groundwaters. Lithospheric materials such as granite, basalt, tuff, and salt generally contain alkaline groundwater, and therefore Am is not expected to be very mobile in this environment. The chemical form of Am in aqueous solution is probably Am(OH)2+; the form in soil was not determined, but is probably not Am(OH)3. Published data on sorption coefficients of Am by different rocks, soils, and minerals were evaluated. Final Am solution concentrations calculated from sorption coefficients of earth materials with solutions agreed well with concentrations predicted from the solubility of solid Am in soil. This indicates that sorption coefficient data are controlled by Am precipitation. (Cassar-FRC)
W82-04720

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,
Moody and Associates Inc., Meadville, PA.
B. A. Waite.
Mining Engineering, Vol 34, No 2, p 170-171, February, 1982.

Descriptors: *Monitoring, *Groundwater movement, *Coal mining, Mining engineering, *Regulations, Dewatering, Drainage effects, Observation wells, Wells.

The coal mining industry has been concerned about the new regulations requiring groundwater monitoring of underground mines. A study of 30 monitoring plans for existing mines in Pennsylvania, West Virginia, and Ohio indicates that for deep mines ranging from 20-81 sq km, 5 to 20 monitoring wells will be required. Variables to consider in electing monitoring locations are aerial coverage of the mine, topographic and structural settings, position of the aquifer in relation to coal seams, population densities, and mining status of various sections of the mine. Possible problems caused by installing monitoring wells include caveins, undesirable dewatering, and disruption of mining plans. Methods for minimizing adverse effects on groundwater are sealing mining openings on completion of mining, providing additional roof supports in wet areas, and avoiding excessively fractured zones. Mine operators face difficulties in collecting data and in being responsible for groundwater supply and quality. For example, considerable money and time may be expended trying to substantiate or refute lost water claims. Future development in a dewatered area may force the coal company to provide a water supply for home owners and industry. It may be difficult or impossible to obtain permission to enter private property and adjacent coal mines to obtain data as required for regulatory compliance. (Cassar-FRC)
W82-04750

5C. Effects Of Pollution

METABOLIC RESPONSES OF AQUATIC BACTERIAL POPULATIONS TO SELECTED INSECTICIDES,
Texas Univ. Health Science Center at Houston. School of Public Health.
H. E. Murray, and R. K. Guthrie.
Water Resources Bulletin, Vol 16, No 4, p 749-751, August, 1980. 3 Fig, 9 Ref.

Descriptors: *Bacteria, *Insecticides, *Oxygen uptake, Water pollution effects, Biodegradation, Metabolism, Malathion, Sevin, 1-Naphthol, Aquatic bacteria, Warburg respirometry, Lake Houston samples, Laboratory tests, Aquariums.

Bacterial populations from Lake Houston were exposed in laboratory aquariums to 5 mg per liter concentrations of sevin or malathion at temperatures of 23, 28, and 33 C. Predominant genera were Pseudomonas, Alcaligenes, Flavobacterium, Bacillus, and Enterobacter. Increased uptake of oxygen as measured by Warburg manometry indicated degradation of sevin by the bacteria. Addition of 1-naphthol, the principal degradation product of sevin, produced the same stimulation of bacterial growth. Plate counts were higher for 3-5 days following sevin or 1-naphthol addition and returned to normal after 10-14 days. Addition of malathion or malathion monocarboxylic acid did not affect metabolic rates at any temperature. However, at 33 C a slight inhibition in bacterial growth was noted. Bacterial counts rose when malathion was reapplied to the aquariums after 2 weeks, possibly indicating a selection of genera able to metabolize the chemical. (Cassar-FRC)
W82-04257

EFFECTS OF PHENOL ON OXYGEN CONSUMPTION IN THE WHELK, BULLIA DIGITALIS (DILLWYN),
Cape Town Univ., Rondebosch (South Africa). Dept. of Zoology.
T. Golombick, and A. C. Brown.
South African Journal of Science, Vol 76, No 8, p 375, August, 1980. 16 Ref.

Descriptors: *Phenols, *Shellfish, *Toxicity, Oxygen demand, *Sea water, Control waters, Effluents, Industrial wastes, *South Africa, Water pollution effect.

High concentrations of pheolic compounds were found from an industrial effluent discharging into the sea on the west coast of south Africa near Cape Twon. To assess potential effect of the discharge, oxygen consumption in large female whelks (Bullia digitalis) was measured after exposure to phenol in natural sea water at 15 deg C. Animals exposed to 0.1% phenol for five minutes died after returning to sea water. Those exposed to 0.005% phenol all recovered although stress symptoms were noted. At 0.1% phenol, oxygen uptake showed an immediate sharp decrease and fell to about 1/5 the control level. At 0.005% phenol, oxygen uptake increased to double the control value. thus, high concentrations caused a decrease and low concentrations caused an increase. These results are consistent with results found by other researchers with other invertebrates. (Small-FRC)
W82-04262

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,
Brown and Caldwell, Sacramento, CA.
E. M. Archibald, and G. F. Lee.
Journal of the American Water Works Association, Vol 73, No 11, p 590-599, November, 1981. 13 Fig, 2 Tab, 14 Ref.

Descriptors: *Lakes, *Eutrophication, *Phosphorus, *Lake Ray Hubbard, *Texas, Dallas, Water quality, Reservoirs, Water pollution effects, Dissolved oxygen, Oxygen, Taste, Odor, Model studies, Algae, Nutrients, Chlorophyll a, *Water pollution control.

Lake Ray Hubbard, Texas, used for drinking water and recreation by the Dallas Water Utilities, was the site of algal-related taste and odor problems during the mid-1970's. The lake, of area 550 million cu m and average depth 6.3 m, is divided into four areas, the Main Body and three arms. Extensive water quality sampling and application of the Organization for Economic Cooperation and Development eutrophication models showed that low flows from the Lake Lavon arm into the Main Body increased the average chlorophyll a levels from 6.5 to 11.5 micrograms per liter for 1976-77 data. The models predicted that an 85% reduction in phosphorus in domestic wastewater discharged into the lake would significantly improve water quality. However, it is unlikely that the P load can be sufficiently reduced to maintain oxygen in the hypolimnion during the thermal stratification period unless period unless both point and nonpoint pollution sources are strickly controlled. Increased population in the watershed will aggravate the problems of disagreeable tastes and odors, shortened filter runs, and trihalomethane formation. (Cassar-FRC)
W82-04278

DIEL VARIATION IN THE ABUNDANCE, VERTICAL DISTRIBUTION, AND SPECIES COMPOSITION OF PHYTOPLANKTON IN A EUTROPHIC ENGLISH LAKE,
Freshwater Biological Association, Ambleside (England).
E. Frempong.
Journal of Ecology, Vol 69, No 3, p 919-939, 1981. 7 Fig, 2 Tab, 58 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Lakes, *England, Vertical distribution, Seasonal variation, Stratification, Thermal stratification.

The diel distribution of chlorophyll and component species throughout the water column in a productive English lake over a range of seasonal phases is discussed. Esthwaite Water is the lake, with an area of about 1 square kilometer, a mean depth of 6.4 meters, and a maximum depth of about 15.5 meters. The lake is composed of three basins. About 83% of the total lake volume is within the 8 meter depth isobath. Eight sampling periods were arranged between June 1977 and September 1978. The seasonal variation of environmental factors, such as thermal and density stratification, largely controlled the size of the diel variations in biomass concentrations. Under strongly stratified conditions and with little turbulence the amplitude of the diel variations increased, and the influence of many factors was restricted to the upper water layers. High daytime light flux influenced the distribution of the dominant motile algae. Sub-surface population maxima under high surface light flux were also noted for two buoyant species, Anabaena flos-aquae and A. solitaria. Loss or accumulation of phytoplankton at the sampling site by lateral transport was associated with wind-induced water movements. Two flagellates, Ceratium hirundinella and Cryptomonas ovata, showed diel vertical migration. Pseudo-diel variations were recognized and linked to weather events with some degree of regularity. (Baker-FRC)
W82-04294

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,
Brookhaven National Lab., Upton, NY.
For primary bibliographic entry see Field 5B.
W82-04302

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,
Texas Univ. at Austin. School of Public Health.
R. K. Guthrie, U. A. Anugwelem, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1005-1007, December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on bacteria were studied on pure and mixed cultures. Bacteria were the indicators, Escherichia coli, and Streptococcus faecalis, and the pathogens, Salmonella typhimurium and Staphylococcus aureus. Oxygen uptake was inhibited by 5 mg per liter carbaryl in all pure cultures. E. coli and . typhimurium pure cultures showed increased oxygen uptake in 1 mg per liter carbaryl. Mixtures of all 4 bacteria showed no increase in oxygen uptake. Carbaryl at 1 and 5 mg per liter significantly inhibited oxygen uptake for mixtures of E. coli-S. faecalis and E. coli-S. aureus, significantly increased oxygen uptake for E. coli-S. typhimurium, and insignificantly increased oxygen uptake for S. typhimurium-S. aureus. Carbaryl had no effect on S. typhimurium-S. faecalis mixtures. Survival times in 5 mg per liter carbaryl were > 8 days for pure and mixed cultures of E. coli, pure cultures of S. faecalis, and mixed cultures of S. typhimurium; < 8 days for pure and mixed cultures of S. aureus, mixed cultures of S. faecalis, and pure S. typhimurium. In mixed cultures in the presence of carbaryl the one pathogen (S. typhimurium) had increased survival time and one indicator (S. faecalis) had reduced survival time. This would make S. faecalis unsuitable as an indicator of fecal pollution under these conditions. (Cassar-FRC)
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,
Ife Univ. (Nigeria). Dept. of Environmental Health.
U. A. Anugwelem, R. K. Guthrie, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1000-1004, December, 1981. 3 Fig, 9 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on fecal pollution indicators (Escherichia coli and Streptococcus faecalis) and the pathogens (Salmonella typhimurium and Staphylococcus aureus) were determined by plate counts and Warburg respirometry. Growth of gram negative bateria, E. coli and S. typhimurium, were initially stimulated by carbaryl, whereas gram positive bacteria, S. faecalis and S. aureus, were inhibited. Over the 8 day study all bacteria died off more rapidly in the presence of carbaryl. Small concentrations of carbaryl can lead to incorrect conclusions in bacterial analysis of water. In some cases indicators died off before pathogens, contrary to the requirements for an indicator bacteria. The ratio of fecal coli to fecal streptococci would lead to false impressions during the period of initial growth stimulation. (Cassar-FRC)
W82-04342

WHEN A WATER SUPPLY WENT BAD,
American City and County, Vol 96, No 12, p 33, 35-36, December, 1981.

Descriptors: *Municipal water, *Chemical wastes, *Activated carbon, *Water pollution effects, *Water treatment, Adsorption, Trichloroethylene, Water supply, Rockaway, *New Jersey, Organic compounds, Political aspects.

Two New Jersey communities, Rockaway Borough and Rockaway Township, handled toxic organic chemical pollution of their water supplies by installing activated carbon water treatment systems. Testing of municipal well water showed trichloroethylene levels as high as 554 ppb in borough water and 180 ppb in township water. The township water was also contaminated with diisopropyl ether and methylene chloride, gasoline additives leaking from a gas station storage tank. Potable water was supplied to residents from water trucks until the activated carbon treatment systems were placed in operation, 21 days for the township and about 6 weeks for the borough. Although sources of chemicals were identified and corrective measures taken, high levels of organic chemicals remained in the well water. However, the carbon adsorption systems removed the contaminants to below the 1 ppb detection limit. (Cassar-FRC)
W82-04357

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
For primary bibliographic entry see Field 2G.
W82-04359

COMBINED EFFECTS OF CADMIUM AND ZINC ON A LAKE MICHIGAN ZOOPLANKTON COMMUNITY,
Argonne National Lab., IL.
J. S. Marshall, D. L. Mellinger, and J. I. Parker.
Journal of Great Lakes Research, Vol 7, No 3, p 215-223, 1981. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Cadmium, *Zinc, *Toxicity, *Zoopankton, Metals, Heavy metals, Crustaceans, Lakes, *Lake Michigan, *Green Bay, *Water pollution effects, Population density, Dissolved oxygen, Species diversity, Species composition.

The effects of cadmium and zinc alone and in combination on the zooplankton community of Green Bay, Lake Michigan, were studied in situ during duplicate 3-week experiments conducted in

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8 liter plastic carboys suspended in the epilimnion. Metal treatments (all in micrograms per liter) were: (1) Cd, 2; (2) Zn, 100; (3) Cd, 2, plus Zn, 100, and (4) Cd, 1 plus Zn, 50. Cd109 and Zn 65 were used as tracers to determine the sorption of Cd, and Zn by the different particle size fractions. All four treatments significantly reduced total crustacean density, species diversity, community similarity indexes, and final dissolved oxygen concentrations during the August 1-22, 1978, run. Average crustacean densities for the treatments were: control, 68 plus or minus 11.9, (1) 46.1 plus or minus 15.4, (2) 21.9 plus or minus 6.0, (3) 17.3 plus or minus 1.4, and (4) 30.8 plus or minus 6.4. The effects of treatment (3) were similar to those of 100 micrograms Zn per liter alone since Cd uptake by zooplankton was reduced by the Zn. Results suggest that less than a ten-fold increase in Zn levels in the lake (from the present 5 micrograms per liter) would have pronounced effects on the plankton community. (Cassar-FRC)
W82-04379

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,
Waterloo Univ., (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04383

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,
Illinois Natural History Survey, Chicago.
A. R. Brigham, L. B. Suloway, and L. M. Page.
Document No. 81/37 November 1981. Illinois Department of Energy and Natural Resources, Chicago. 16 p, 5 Fig, 8 Tab, 24 Ref.

Descriptors: *Sedimentation, *Substrates, Sediments, Sand, Silt, *River flow, Biological samples, Biomass, Benthic flora, Benthic fauna, Macroinvertebrates, Rivers, Mussels, Fish, Fish populations, *Ecological effects, *Aquatic life, *Kankakee River, Illinois.

Increased sediment transport is considered the most serious water pollution problem in Illinois. Of concern is that when sediments washed into the Kankakee in Indian reach the slower-moving Illinois portion of the river, diversity and abundance of aquatic life are reduced. The objectives of this study were to assess the impact in Illinois of upstream activities that might increase sediment transport, especially upstream of Kankakee, by quantitatively estimating principal macroinvertebrate populations associated with known substrate types, and to combine this sampling with other sampling to assess the status of endangered or threatened species. In 1979, 44 species of fish were collected. Sites where sand or silt-sand substrates predominated supported fewer species, fewer individuals, and lower biomass than sites with coarser substrates. The transition area had about the same number of species and biomass but fewer individuals as sites where coarser substrates predominated. Thireeen species of mussels were collected. Predominantly sand substrates support few, if any, mussels. Density and number of species were varied at sites with substrates other than predominantly sand. Sedimentation of the non-sand areas would destroy part of the mussel fauna. Also in 1979, 143 taxa of benthic macroinvertebrates were collected. Sites with progressively more complex substrates supported more taxa. Sites where sand or sand-silt substrates predominated supported fewer taxa than sites with substrates composed of silt, sand, gravel, cobble and/or bedrock. (Atkins-Omniplan)
W82-04389

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,
Illinois Natural History Survey, Urbana.
W. U. Brigham, and D. L. Hey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109828, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-217, October, 1981. 4 p, 1 Tab. R-805614-01-0

Descriptors: *Water quality management, *Computer models, *Toxicity, *Water pollution effects, *Bluegills, *Stress, Carp, Aquatic environment, Ammonia, Seasonal variation, Combined sewer overflows, Oxygen demand, Effluents, Residual chlorine, Fish.

This investigation explores the relationship between biological communities and the physical and chemical conditions in the aquatic environment. Seasonal patterns and the duration and probability of the occurrence of chemical conditions and physicial events are established by means of computer modelling. An instantaneous measure of stress is calculated by summing the decimal fractions of the 96-hr lethal concentrations (for bluegills) of each of 21 toxicants. These data are summarized as a quasicontinuous stress function calculated over 1-hr intervals. The stress function is related to five distinct biological communities ranging from the most to the least tolerant of pollution. Data from a test watershed in northeastern Illinois yielded stress functions as follows: 0.120 to 783.7 (mean 23.02) from a site with no fish, 0.155 to 98.47 (mean 1.038) from a site with a carp population, and 0.005 to 0.279 (mean 0.116) from a site with a bass population. A hypothetical management plan to reduce the ammonia component at the no-fish site was incorporated into the stress function. This plan limited effluent ammonia concentrations to 1.5 mg/liter during summer months and 4.0 mg/liter during the winter, eliminated combined sewer overlflows, reduced sediment oxygen demand levels substantially, and increased dissolved oxygen levels moderately in treatment plant effluents. Mean stress was reduced from 23.02 to 2.12- more than an order of magnitude. This level was still significantly higher than that of the carp site, primarily because of residual chlorine in the effluents from wastewater treatment plants. These results suggest that if species other than carp are desired in the fishery, further control strategies might need to be implemented. (Author's abstract)
W82-04407

RELATIVE EFFECTS ON STREAM BIOTA OF CHLORINE AND AMMONIA OCCURRING IN SECONDARY SEWAGE,
Southern Illinois Univ. at Carbondale.
W. M. Lewis, R. C. Heidinger, M. H. Paller, and L. J. Wawronowicz.
Document No 81/35, November, 1981. Illinois Department of Energy and Natural Resources. 253 p, 19 Fig, 12 Ref, 14 Append.

Descriptors: *Chlorine, *Ammonia, *Residual chlorine, *Effluents, *Secondary wastewater treatment, Fish toxins, Dissolved oxygen, Turbidity, Fish populations, Algal control, Invertebrates, Stream biota, Water pollution, Streamflow, Toxicity, Pollutants, *Illinois, Water quality standards.

According to Illinois pollution standards, sewage treatment plants cannot legally dischange an effluent which elevates stream total ammonia levels above 1.5 mg/l. Prior studies suggest that chlorine added to secondary sewage effluent as a disinfectant is the principal environmental toxicant, not ammonia, as was previously thought. This study examined the relative effects of the two pollutants. Three streams receiving chlorinated secondary sewage were monitored for significant biotic and abiotic variables. After a year, chlorination was stopped to observe any changes that might occur when only ammonia was present. It was found that eliminating residual chlorine from god quality secondary sewage effluents will result in quantitative and qualitative restoration of fish communities. Further conclusions were that eliminating residual chlorine from poor quality sewage effluents will not necessarily revive fish communities; that high ammonia-nitrogen concentrations did not affect the distribution of fishes in these three streams (but might in high quality streams with much pollution-sensitive taxa); that effluent turbidity can limit fish distribution; that cessation of chlorination did not result in excessive algal growth and significant decreases in dissolved oxygen if effluent quality is good and flow rates are moderately high; that invertebrate communities may show favorable quantitative but not qualitative responses to chlorination cessation in good quality secondary sewage effluent; and that the effects of highly toxic sewage may be more severe in winter than in summer. In most cases, cessation of chlorination will be environmentally more beneficial than tertiary ammonia removal. (Atkins-Omniplant)
W82-04409

THE ECOLOGICAL SIGNIFICANCE OF A STUNTED WHITE PERCH POPULATION IN AN EUTROPHIC MAINE POND,
Maine Univ. at Orono. Land and Water Resources Center.
R. Hines.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211517, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, May, 1981. 45 p, 8 Fig, 10 Tab, 61 Ref, 1 Append. OWRT B-018-ME(1).

Descriptors: Fish food organisms, Fish management, *Fish populations, *Eutrophic lakes, Food chains, *Perch, Trophic level, *Growth rates, White perch, Hermon Pond, *Maine, Ecological effects.

A study was conducted to evaluate the ecological role of an abundant white perch (Morone americana Gmelin) population in an eutrophic pond, Hermon Pond, Maine. Data on growth and feeding habits for this population were combined with published literature to construct food web models for the pond community. The responses of these model systms to the manipulation of fish stocks were predicted using loop analysis with special attention being paid to those changes that would affect fishing and water quality. The diet composition of yearling-plus white perch varied markedly with season and size. In August and September, 1979, and in July, 1980, perch less than 220 mm fed largely on the aquatic larvae and pupae of Diptera. In May, 1980, the diet was a mixture of immature insects and cladocerans. By June, these perch were feeding mainly on daphnids. White perch larger than 220 mm were largely piscivorous. Growth and age determinations indicated that the white perch population was characteristically stunted. The growth rate of white perch in the study population was slow when compared with growth rates reported for populations in other waters; however overabundant and stunted populations are common in many other areas. Several studies indicate that predation pressure may counteract the species' tendency to overpopulate and stunt. Loop analysis of the seasonal food web models suggests that management efforts for white perch should be directed at reducing the number of young-of-the-year. The introduction of an openwater piscivore may be a way to implement this strategy in eutrophic Maine waters.
W82-04418

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,
Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 5B.
W82-04420

HEALTH EFFECTS OF ALTERNATE DISINFECTANTS AND THEIR REACTION PRODUCTS,
Environmental Protection Agency, Cincinnati, OH.
R. J. Bull.
Journal of the American Water Works Association, Vol 72, No 5, p 299-303, May, 1980. 10 Tab, 19 Ref.

Descriptors: *Disinfection, *Water treatment, *Chlorinated hydrocarbons, *Toxicity, Water pollution effects, Chlorination, Chlorine dioxide, Ozone, Chlorine, Chloramine, Drinking water, Organic compounds, Carcinogens, Public health, Chlorites, Trihalomethanes, Reviews.

The health effects of the water disinfectants, chlorine dioxide, chloramines, and ozone, are reviewed. Many studies concentrated on chlorine dioxide and its inorganic byproducts, chlorite and chlorate. Chlorite produces methemoglobinemia in humans and laboratory animals. Unlike nitrite, chlorite is hemolytic. Similar changes are produced by chlorate, but the observed changes disappear with continued exposure after 2 months. No significant effects of 5 mg per liter chlorite in drinking water were observed in the population of a small town. However, red cell glutathione and 2,3-diphosphoglyceric acid were not determined. One individual with glucose-6-phosphate dehydrogenase deficiency showed 15% decreases in hemoglobin and hematocrit during the period when chlorite was used for disinfection. Rats exposed to monochloramine in drinking water at concentrations up to 100 mg per liter for 45 days showed no overt adverse effects. However, patients undergoing kidney dialysis with chloramine-treated water suffered acute hemolytic anemia. The organic reaction products of disinfectants include trihalomethanes, known carcinogens. One study investigated the susceptability of mice to tumors produced by painting the skin with tumor promotors and disinfected Ohio River water concentrated by a factor of 102-186 by reverse osmosis, which does not concentrate trihalomethanes, but higher molecular weight compounds. No tumors were produced by nondisinfected water or water treated with chlorine dioxide plus tumor promotor. Tumors were produced by disinfection reaction products plus tumor promotors as follows: chlorine, 4 of 25 animals; chloramine, 5 of 25 animals; and ozone, 7 of 25 animals. (Cassar-FRC)
W82-04422

EFFECTS OF PETROLEUM HYDROCARBONS ON PLANT LITTER MICROBIOTA IN AN ARCTIC LAKE,
Cincinnati Univ., OH. Dept. of Biological Sciences.
V. L. McKinley, T. W. Federle, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 1, p 129-135, 1982. 4 Fig, 32 Ref.

Descriptors: *Lakes, *Hydrocarbons, Biomass, Arctic, Polar regions, *Environmental effects, Arctic zone, Microbiological studies, Leaves, Microorganisms, Plant litter, Oil, *Toolik Lake, *Alaska.

The short term effects of Prudhoe Bay crude oil, diesel fuel, and toluene on microbial adenosine triphosphate (ATP) levels and the rate of acetate incorporation into microbial lipids on colonized Carex sedge leaf litter were examined. Study was also made of the effects of Prudhoe Bay crude oil, motor oil, diesel fuel, gasoline, hexane, and toluene on Carex lignocellulose mineralization by Toolik Lake sediments. Microbial metabolic activity, measured as the rate of acetate incorporation into lipid, did not vary significantly from controls over a 12 hr period after exposure of colonized Carex litter to 3.0 ml of Prudhoe Bay crude oil, diesel fuel, or toluene per liter. ATP levels were elevated within 2 hr after exposure to diesel fuel or toluene, but returned to control levels after 4 to 8 hr. Mineralization of specifically labeled lignocellulose by Toolik Lake sediments was inhibited 58, 67, 67, and 86% by exposure to diesel fuel, motor oil, gasoline, and toluene, respectively. Hexane-treated samples displayed an increase in the rate of lignocellulose mineralization of 33%. Mineralization of the labeled lignin component of lignocellulose appeared to be more sensitive to hydrocarbon perturbations than was the labeled cellulose component. (Baker-FRC)
W82-04455

EFFECT OF WATER POLLUTANTS AND OTHER CHEMICALS UPON THE ACTIVITY OF LIPASE IN VITRO,
Environmental Research Lab.-Duluth, MN.
G. M. Christensen, and B. Riedel.
Archives of Environmental Contamination and Toxicology, Vol 10, No 3, p 357-363, 1981. 2 Tab, 9 Ref.

Descriptors: *Pollutants, *Water pollution effects, *Enzymes, Mercury, *Heavy metals, Chemical reactions, *Lipids, Organic compounds, Inorganic compounds, Pesticides.

Lipase is an important lipid enzyme which may be particularly vulnerable to some highly lipid-soluble environmental chemicals which bioaccumulate in lipid-rich tissue when their rates of degradation or elimination are relatively slow. This study investigated the effects of 100 organic and inorganic chemicals representative of some of the major types of chemical water pollutants on lipase activity. The chemicals tested included thiomides, thiocarbamates, organothiophosphates, urea derivatives, antibiotics and other biocides, aromatic halogenated hydrocarbons, aliphatic halogenated hydrocarbons, phenols and halophenoxy acids, solvents and other industrial chemicals, inorganic salts (both active cations and active anions), organo-metals, carcinogens, and several miscellaneous chemicals. The mercuric ion was found to have the strongest inhibitory effect, followed by other heavy metals, pentachlorophenol, and dicofol. The enzyme was generally found to be relatively highly sensitive to many of the heavy metal cations that are toxic to aquatic animals. Chlorinated phenols and chlorobenzene pesticides were the most inhibiting of the organic chemicals tested, followed by warfarin and malathion. Organometals, phenyl mercuric chloride, and methyl mercuric chloride had intermediate inhibitory effects. Some anions usually considered fairly toxic were found to have only a slight or negligible effect. The four organic carcinogens tested were relatively uninhibiting. The inhibitory effect of a mixture of 10 inorganic salts on lipase was shown to develop through an accumulation of the effects of the components. None of the chemicals studied caused a measurable activation of the enzyme. (Carroll-FRC)
W82-04462

THE RESTORATION OF VEGETATION IN LAKES IN THE PODA LOCALITY NEAR BURGAS AFTER DISCHARGING OF BIOLOGICALLY PURIFIED WASTE WATERS (VUZSTANOVIAVANE NA RADTITELNATA POKRIVKA V SUBIRATELNITE EZERA V MESTNOSSTTA PODA KRAI BURGAS SLED PUSKANETO NA BIOLOGICHNO PRECHISTENI OTPADUCHNI VODI V TIAKH),
Bulgarian Academy of Sciences, Sofia. Inst. of Botany.
I. A. Bondev, and S. Ya. Simeonov.
Ekologiia, Vol 9, p 28-36, September, 1981. 2 Fig, 3 Ref. English Summary.

Descriptors: *Lakes, *Lake restoration, *Macrophytes, Aquatic plants, *Water pollution effects, *Industrial wastes, Petroleum industry, Mapping, Comparative productivity, Bulgaria.

Higher macrophyte vegetation was completely destroyed by dredging operations and oil pollution in the collecting ponds at Poda, which received wastes from a petroleum plant in 1963-1971. Following the construction of a biological treatment plant in 1972, the water purity improved, and gradual restoration of the macrophytes began. The restoration process was followed by mapping, and began in 1973 with the appearance of single Phragmites communis L. at the edges of the lake. In 1974 Typha angustifolia and Bolboschoemus maritimus L. also appeared. By 1978 the vegetation covered 16.2% of the fourth lake. The greatest annual vegetation increase, 8.36%, was seen in 1975. Phragmites communis L. showed the most rapid recovery, accounting for 98.37% of the surface currently covered by vegetation. The stem height and diameter as well as the biological productivity of Phragmites communis were lower than in control lakes. The other two species recovered more slowly.
W82-04476

CYTOGENETIC EFFECTS ON THE EASTERN MUDMINNOW, UMBRA PYGMAEA, EXPOSED TO ETHYL METHANESULFONATE, BENZO(A)PYRENE, AND RIVER WATER,
Nijverheidsorganisatie TNO, Delft (Netherlands).
R. N. Hooftman, and G. J. Vink.
Ecotoxicology and Environmental Safety, Vol 5, No 3, p 261-269, 1981. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Fish, *Mudminnow, *Mutagens, *Water pollution effects, *Ethyl methanesulfonate, Benzopyrene, Rivers, *Rhine River, Bioindicators, Aromatic compounds, Organic compounds.

The eastern mudminnow, Umbra pygmaea, was a suitable bioindicator for detecting cytogenetic effects of chemical pollutants in the aquatic environment. Groups of fish were exposed to two known genotoxic agents, ethyl methanesulfonate and benzo(a)pyrene, and to polluted Rhine River water sampled near Lobith, the Netherlands. Best results were obtained with gill tissue after 2 injections with bromodeoxyuridine. Chromosome damage was found in fin and gill tissue. Chromatid aberrations were most common, but chromosome breaks were also found. A 2-day exposure to ethyl methanesulfonate at concentrations of 0, 18, 40, and 200 mg per liter produced 0.3, 1.1, 6.8, and 19.6% metaphases with chromosome aberrations, respectively. Benzopyrene at concentrations of 0.00001 mg per liter produced no metaphase aberrations. At the 0.0001 mg per liter level, exposures of 2, 4, and 6 days gave aberrations of 0.3, 1.5, and 1.8%, respectively. Rhine River water caused 0.7, 2.5, and 4.1% metaphases with chromosome aberrations at 8 days exposure to water diluted by high flow, and 8 and 14 days exposure to less diluted low flow water, respectively. Sister chromatid exchange induction analysis after 8 days exposure to Rhine River water produced fin and gill metaphase aberrations of 7.0-8.4% and 5.0-5.2%, respectively, compared with the control, 2.2-2.7%. (Cassar-FRC)
W82-04480

EFFECTS OF LAND USE ON SURFACE-WATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-176520, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-59, 1982. 37 p, 2 Fig, 22 Tab, 7 Ref.

Descriptors: *Land use, *Surface water, *Water quality, *Environmental effects, Agricultural chemicals, Runoff, Wetlands, Nutrients, Data collections, Water pollution effects, Pesticides, Bacteria, *Florida, *Dade County, Everglades.

Water-quality characteristics were determined at five developed areas in the East Everglades, Dade County, Florida, during the 1978 wet season (June through October). These areas are designated as: Coopertown; Chekika Hammock State Park; residential area; rock-plowed tomato field; and Cracker Jack Slough agricultural area. Data from the developed areas were compared with data from four baseline sites in undeveloped areas to determine the effects of land use on the surface-water quality. The rock-plowed tomato field was the only area where surface-water quality was affected. Water quality at this field is affected by agricultural activities and chemical applications as indicated by increased concentrations of orthophosphate, organic nitrogen, organic carbon, copper, manganese, mercury, and potassium. The remaining four areas of land use had water-quality characteristics typical of baseline sites in nearby Northeast Shark River Slough or Taylor Slough. Chemical analyses of soil indicated chlorinated-hydrocarbon insecticide residues at Coopertown and the two agricultural areas, Cracker Jack Slough and the rock-plowed tomato field. Trace elements in concentrations greater than base level occurred at both agricultural areas (manganese), Chekika Hammock State Park (manganese), and at Coopertown (lead and zinc). (USGS)
W82-04491

BIOTA AND BIOLOGICAL PRINCIPLES OF THE AQUATIC ENVIRONMENT.
Geological Survey, Reston, VA. Water Resources Div.
Available from Dist. Branch, USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 848-A, 1982. 49 p, 29 Fig, 1 Tab. (Greeson, P.E., editor).

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Descriptors: *Biota, *Water quality, *Biological communities, *Aquatic environment, *Water pollution, Environmental effects, Ecosystems, Algae, Streams, Phytoplankton, Invertebrates, Microorganisms, Midges, Water temperature, Channeling, Fauna.

This is the first of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological principles of the aquatic environment. Briefing papers are included on 'Why biology in water-quality studies', 'Stream biology', 'Phytoplankton', 'Periphyton', 'Drift organisms in streams', 'Family Chironomidae (Diptera)', 'Influences of water temperature on aquatic biota', and 'Stream channelization: Effects on stream fauna'. (USGS)
W82-04499

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. F. Ferrieria.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137696, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-61, October, 1981. 21 p, 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Streamflow, *Coal mines, *Irrigation effects, Evaluation, Forecasting, Flow characteristics, Surface runoff, Land use, Data collections, *Montana, *Fort Union coal region.

Streamflow characteristics of drainage basins within the Forst Union coal region of southeastern Montana were estimated to provide premining data for evaluating the future effects of mining on the environment. Estimated annual mean streamflow at 22 data-collection stations for water years 1975-77 ranged from 0 to 887 cubic feet per second. These estimates are based on miscellaneous-streamflow records at each station and continuous-streamflow records from other stations in the study area. Estimated mean annual streamflow for a 10-year period (water years 1968-77) ranged from 0 to 572 cubic feet per second. These long-term estimates were based on data from stations in the surrounding area having continuous-streamflow records. Estimates mean annual runoff in inches for selected drainage basins within the study area showed no discernible pattern. Many of the drainage basins had a mean annual runoff of less than 0.60 inch; the maximum observed mean annual runoff was 4.45 inches. (USGS)
W82-04506

AN ANNOTATED KEY TO THE IDENTIFICATION OF COMMONLY OCCURRING AND DOMINANT GENERA OF ALGAE OBSERVED IN THE PHYTOPLANKTON OF THE UNITED STATES,
Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.75. Geological Survey Water-Supply Paper 2079, 1982. 138 p, 58 Fig, 4 Tab, 123 Ref.

Descriptors: *Algal, *Phytoplankton, *Taxonomy, *Water quality, Hydrologic data, United States, Genera, *Genera identification.

In early 1979, a retrieval was made for all phytoplankton data contained in the computerized data file of the U.S. Geological Survey. The retrieval revealed the analytical results of 17,959 samples collected and processed between October 1973 and October 1978. Of the approximately 500 genera of fresh-water algae reported in the United States, the U.S. Geological Survey observed 321 genera in the phytoplankton. Fifty-two genera were considered to be commonly occurring and 42 genera were considered to be community dominants. The report lists, describes, and provides a detailed taxonomic key for the identification of 58 genera of algae considered either commonly occurring or dominant. Also included is a summary of environmental conditions under which each algal genus was observed, as well as a glossary and an extensive list of selected references. (USGS)
W82-04524

TOXICITY OF NITRITE TO LARVAE OF THE SALAMANDER AMBYSTOMA TEXANUM,
North Texas State Univ., Denton. Dept. of Biological Sciences.
D. W. Huey, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 909-912, 1980. 1 Tab, 16 Ref.

Descriptors: *Nitrites, *Salamanders, *Toxicity, Water pollution effects, Nitrogen compounds, Mortality, Aquatic animals, Texas, Ponds.

Larvae of the salamander, Ambystoma texanum, from a Texas pond were highly sensitive to nitrite in low chloride (5.0 mg per liter) water. The 96 hour LC50 was 1.09 mg per liter nitrite. Nearly 100% mortality was seen at concentrations of 2.5 mg per liter nitrite and above. In water containing 300 mg per liter chloride and 10 mg per liter nitrite, no mortality was observed in 96 hours, probably as a result of lower nitrite uptake rates. (Cassar-FRC)
W82-04529

A METHOD FOR DETERMINING STRESS IN WETLAND PLANT COMMUNITIES FOLLOWING AN OIL SPILL,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Environmental Pollution, Series A: Ecological and Biological, Vol 26, No 4, p 297-304, December, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Marsh plants, *Stress, *Sublethal effects, *Carbon dioxide, Photosynthesis, Toxicity, Marshes, Spartina, Ecosystems, Plant pathology, Wetlands, *Oil spills, Gas chromatography, Water pollution effects, *Ecological effects.

A portable gaseous exchange chamber was developed to measure sublethal stress, such as the effects of oil spills, in wetland plant communities. The system, which requires no on-site electricity, was tested in Louisiana salt marsh on Spartina alterniflora by measuring carbon dioxide fixation rates. Stresses studied were manmade (two concentrations of crude oil) and natural (streamside and inland location). The procedure involved placing light and dark chambers adjacent to each other on marsh plants for about 20 min. Air samples were taken every 5 min and analyzed for carbon dioxide by a gas chromatograph equipped with a flame ionization detector and a catalytic conversion unit to quantitatively reduce CO2 to CH4. The samples were analyzed within 24 hours after collection in an off-site laboratory. After 7 and 14 days exposure the oil-treated plants had fixation rates 19-37% of those in the control plants. In the plants suffering natural water stress, the shorter inland plants had carbon fixations equal to 27-34% of that of the taller streamside plants. (Cassar-FRC)
W82-04548

NITRIFYING POPULATION DENSITIES AND INHIBITION OF AMMONIUM OXIDATION IN NATURAL AND SEWAGE-ENRICHED CYPRESS SWAMPS,
Florida Univ., Gainesville, Dept. of Environmental Engineering.
F. E. Dierberg, and P. L. Brezonik.
Water Research, Vol 16, No 1, p 123-126, January, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Nitrification, *Wastewater disposal, *Bacteria, Cypress, Water pollution effects, Organic matter, Ammonium, Oxidation, Nitrates, Swamps, Peat, *Florida.

The densities of autotrophic nitrifiers in peat from the floors of cyress domes near Gainesville, Florida, were investigated. One dome received groundwater from a deep artesian aquifer, two were amended with secondary treated sewage effluent, and a fourth was left in the natural state. Nitrifying bacterial densities as determined by the most probable number method (in cells per ml) were as follows: groundwater dome, 78-7900; sewage domes, 350->160,000; and natural dome, 0-56. mmonium concentrations (in mg per liter) were as high as 24.5 in the sewage domes, 3.8 or less in the groundwater dome, and 0.55 or less in the natural dome. Water from the natural dome was used for nitrification rate studies. It was determined that the low pH (4-5) and not dissolved humic materials was responsible for nitrification inhibition. The pH value of the sewage domes was 6-7, more favorable for nitrification. Nitrification inhibition, as seen in natural cypress domes, prevents N losses in these ecosystems because ammonium ion, the dominant inorganic N species, does not leach from the root zone as readily as nitrate. (Cassar-FRC)
W82-04556

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-04567

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),
Arago Lab., Banyuls-sur-Mer (France).
For primary bibliographic entry see Field 5B.
W82-04672

SEASONAL VARIATIONS IN PRIMARY PRODUCTION IN SURFACE WATERS OF THE SAGUENAY RIVER (VARIATIONS SAISONNIERES DE LA PRODUCTION PRIMAIRE DANS LES EAUX DE SURFACE DE LA RIVIERE DU SAGUENAY),
Quebec Univ., Chicoutimi. Dept. des Sciences Pures.
R. Cote.
Hydrobiologia, Vol 83, No 1, p 1-10, 1981. 2 Fig, 3 Tab, 19 Ref. English Summary.

Descriptors: *Water pollution effects, *Primary production, *Seasonal effects, Population dynamics, *Chlorophyll, Rivers, Saguenay River, *Heavy metals, Industrial wastewater, Phytoplankton, Tides, River flow.

Seasonal variability of chlorophyll a and primary production rates were investigated at a station on the Saguenay River near Chicoutimi, May-December, 1978. The annual mean flow in the Saguenay may reach 1300 cu m per sec, and surface tides in the range of 4-6 m are present. At this station, with a maximum water depth of 20 m, the photic zone showed a maximum depth of 2 m. Phosphate levels were very low, with a seasonal mean of 0.02 + or - 0.02 microatom-gram per liter, and nitrates relatively high (mean of 5.6 + or - 0.75 microatom-gram per liter). Seasonal dynamics of the river are characterized by absence of a definite spring bloom, a late growth season, and persistently poor phytoplankton biomasses (chlorophyll a maximum of 3.7 mg per cu m). The maximum production rate was 3.5 mg C per cu m per hr, and the correlation between production rate and biomass was poor. This river flows through an industrialized region and receives effluents from metallurgical plants and paper mills, as well as urban runoff. The presence of trace metals (mercury, copper, lead and iron) may account to some degree for the inhibition of phytoplankton growth. (Carroll-FRC)
W82-04678

MICROBIAL ECOLOGY OF RIVER DEPOSITS IN THE RIVERS KENNET AND THAMES AT READING, ENGLAND,

Lyne and Martin Public Analysts, Reading (England).
R. M. Webster.
Process Biochemistry, Vol 16, No 6, p 12-15, 19, October/November, 1981. 3 Fig, 6 Tab, 24 Ref.

Descriptors: *Detritus, *Microbiological studies, *Aquatic plants, Rivers, *Kennet River, *Thames River, Epiphytes, Actinomycetes, Heterotrophic bacteria, Nutrients, Heavy metals, Algal growth, Aeromonas hydrophila, Toxicity, Indicators, Eutrophication, Water pollution effects, *England.

Surveys were conducted on the microbiology of detritus and sediments of the rivers Kennet and Thames. The first survey, in 1974, estimated populations of algae, fungi, yeasts, blue-green algae and bacteria in different detritus and sediment samples. The second survey, in 1979, estimated the populations of heterotrophic bacteria and actinomycetes on the epiphytic detritus accumulated on the leaves of Nuphar lutea, the yellow water lily, and on the benthic detritus of reed beds, indicated in the first studies as sites of high microbial activity. A simplified succession pattern indicates that peaks of yeasts, blue-green algae, Chromobacterium and total bacteria (by microscopic count) are associated with algal peaks in the summer. Peaks of heterotrophic bacteria and micromonosporas which followed the algal peaks were probably stimulated by decay of the algae. During a bloom the greatest increase in numbers was due to Aeromonas hydrophila. The presence of heavy metals inhibited microbial growth in some of the samples. In addition to relatively high levels in May when the sediments were stirred up, heavy metal levels increased to a peak at the end of October, at which time the number of yellow colonies did not increase with the peak of total heterotrophic bacteria. Although interactions appear to exist between nutritional and metabolic stresses, it seems potentially interesting to use A. hydrophila as a bacterial indicator of organic and heavy metal pollution. The ATP assay could also be used as an indicator of toxicity. (Carroll-FRC)
W82-04688

AN INTEGRATED WATER-QUALITY INDEX FOR IRRIGATION USE,
Central Groundwater Board, Lucknow (India).
B. K. Handa.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 422-426, June, 1981. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Irrigation water, Monitoring, Salinity, *Soil contamination, *Plant toxins, *Hazardous materials, Water pollution effects, Mathematical studies.

A water quality index has been developed which takes into consideration the effect of various constituents present in water on its use for irrigation. These constituents were divided into two categories: those that are highly toxic to plants and humans, and those that adversely affect soil characteristics and plant growth and are also a health hazard to humans consuming those plants. The latter properties were further subdivided into several subgroups depending on their relative importance, and a ranking factor was assigned to each subgroup in order of importance. For all waters that presented high salinity and other hazards the index was negative. When positive values of the index were obtained, it was taken to indicate that the water so rated could be used for irrigation purposes. The index proved to be quite useful in comparing the overall quality of irrigation water from various sources. The index itself is very flexible and can be modified for various soils, crops, and irrigation techniques. (Baker-FRC)
W82-04723

PESTICIDES IN THE AQUATIC ENVIRONMENT,
Illinois Univ. at Urbana-Champaign.
D. A. Belluck.
PhD Thesis, 1981. 153 p, 15 Fig, 32 Tab, 159 Ref, 7 Illust. University Microfilms International, Ann Arbor, MI; Order No GAX81-14387.

Descriptors: *Aquatic environment, *Pesticides, *Water pollution effects, Aquatic life, Toxicity, Bioassay, Surface water, *Caddisflies, *Eggs, Organochlorine pesticides, Triaenodes tardus, *Illinois, Xenobiotics.

Organochlorine pesticide data of samples obtained from Clear Creek (Southern Illinois) and Lodge Pond (Central Illinois) are presented. Organochlorine pesticide residue levels in organisms from both aquatic communities suggest that residue concentrations may be primarily determined by the habitat and detoxification capabilities (or biological properties) of an organism rather than by its trophic level position. A new bioassay, the caddisfly egg toxicity bioassay, has been developed to measure the effects of zenobiotics on caddisfly embryogenesis. Results from this bioassay indicate that certain insecticides and herbicides are embryotic and/or teratogenic to eggs of the caddisfly, Triaenodes tardus. Bioconcentration of pesticides by T. tardus egg masses is correlated with the physiochemical properties of the pesticide. A strong correlation exists between water solubility and bioconcentration factor. Passive biological system such as caddisfly eggs can accumulate significant quantities of pesticiede from water. Within 24 hours of exposure to radiolabelled pesticides, egg mass pesticide concentrations were at least equal to that in the surrounding water. The caddisfly egg toxicity bioassay provides a quick (three weeks or less), sensitive and inexpensive technique for use by researchers to determine the effects of xenobiotics on aquatic organisms. This new bioassay enables a biologist to test the unique genetic endowment of a local insect population for resistance or susceptibility to a given compound. (Sinha-OEIS)
W82-04727

5D. Waste Treatment Processes

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,
Water Purification Associates, Cambridge, MA.
For primary bibliographic entry see Field 5F.
W82-04275

EXPERIENCES WITH A PILOT SCALE RESEARCH PLANT FOR PHOSPHATE REMOVAL FROM WASTEWATER WITH ACTIVATED ALUMINA (ERFAHRUNGEN MIT EINER HALBTECHNISCHEN VERSUCHSANLAGE ZUR ABTRENNUNG VON PHOSPHAT AUS ABWASSER MIT AKTIVTONERDE),
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
D. Donnert, S. H. Eberle, P. Gruber, H. Metzger, and H. P. Sapandowski.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 188-193, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Phosphate removal, *Adsorbents, Activated alumina, Pilot plants, Process control, Chemical recovery, Regeneration, Aluminum compounds, Advanced wastewater treatment, Germany.

Prior experiments had revealed the potential usefulness of activated alumina for removing phosphate from wastewaters in a form suitable for recovery. A pilot plant was constructed on the experimental field of the Federal Health Bureau in Berlin to test this process on secondary effluent. The plant comprised four stirring reactors with a volume of 0.44 cu m each, of which three were in use for phosphate adsorption while the fourth was being switched to regeneration of activated alumina. Each reactor is filled with 50 kg of activated alumina.. An automatically operating Phosphatometer measures the phosphorus content in the effluent from each reactor, and when the concentration exceeds 1 mg/liter, a process computer switches the reactor over for regeneration with NaOH solution. The intake line is equipped with a turbidimeter to detect sludge influx during heavy rains. A pressure monitor detects obstructions in the process line, and a pH meter regulates carbon dioxide addition for pH adjustment. An effluent turbidimeter indicates alumina carryover. In trials conducted from November 1980 to April 1981, uniform effluent quality was achieved despite influent phosphorus fluctuations. Approximately 40% reductions in COD and 20% reductions in DOC were also achieved in the alumina step. Regeneration efficiencies were only 60% instead of the anticipated 80%; however, this did not greatly increase operating costs. Alumina losses during regeneration were about 4%. Mean effluent concentrations in the range of 0.6-0.7 mg/liter P were obtained over the trial period. (Carroll-FRC)
W82-04280

USE OF STORMWATER DETENTION BASINS FOR NEUTRALIZATION AND SPECIAL TREATMENT OF TOXICANTS (EINSATZ VON REGENKLARBECKEN ZUM AUSGLEICH UND ZUR SONDERBEHANDLUNG TOXISCHER ABWASSERSTOSSE),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Ingenieurbiologie und Biotechnologie des Abwassers.
F. Kast, K. A. Wippler, and L. Hartmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 218-223, 1981. 8 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Toxicity, *Retention basins, *Heavy metals, Sulfides, Chemical precipitation, Iron compounds, Automation, Process control, *Industrial wastewater, Copper, Zinc, Chromium, Cyanide, Biological wastewater treatment, Diversion, Germany.

Studies were conducted from May 1978 to June 1980 at the Geislingen/Steige wastewater treatment plant regarding the possibility of protecting the biological treatment stage from toxicants with the aid of stormwater dention basins. Recurrent reductions in protozoan populations and impairment of activated sludge settling indicated the influx of toxicants into this plant. In many cases, the heavy metal contents of the filter cake and the activated sludge exceeded the permissible levels for agricultural land disposal. A toxicant warning system was installed, consisting of pH, conductivity and temperature sensors, turbidimeter, Toximeter, and photometers for measuring chromium (VI), copper, zinc, cyanide, oils and grasses. If limiting values for any of these indices are exceeded, a slide valve preceding the treatment plant diverts the wastewater into the stormwater detention basin. A procedure for treating the diverted water at reasonable expense was also developed. Sulfide precipitation was the only practical method found for removing copper and zinc, in the presence of complexants, while 97-99% elimination of chromium(VI) was achieved by sequential addition of iron(II) and iron(III) compounds. The diversion technique was judged reasonably effective; however, the high cost of chemical treatment means that this treatment should not be considered a 'normal' part of the wastewater treatment process. Instead, the industrial dischargers must improve effluent quality so that special treatment will only be required in emergencies. (Carroll-FRC)
W82-04282

WASTEWATER TREATMENT WITH ACTIVATED CARBON ADDITION AT THE AERATION STAGE AND SPENT CARBON REGENERATION. (ABWASSERREINIGUNG UNTER ZUGABE VON AKTIVKOHLE IN DIE BELEBUNGSSTUFE UND REGENERIERUNG DER AKTIVKOHLE),
Uhde (Friedrich) G.m.b.H., Dortmund (Germany, F.R.).
K. Eisenacher, U. Neumann, and J. Kelin.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 168-173, 1981. 11 Fig, 2 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Activated carbon, Biological treatment, *Activated sludge process, Organic compounds, Effluents, Recycling, Regeneration, Pilot plants, Germany.

A wastewater discharging concern, a chemical plant construction company, and a research institution performed a cooperative study aimed at demonstrating the advantages of continuous addition of powdered activated carbon in the biological purification of wastewaters containing refractory organic materials. A pilot plant was constructed, treating

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wastewater from the Griesheim plant of the Hoechst Co., previously subjected to neutralization and sedimentation. Two activated sludge treatment units were used, one with and one without powdered activated carbon. The wastewater contained aliphatic and aromatic, chlorinated and nitrated organic compounds in amounts varying with production demand. Effluent TOC values of 175-355 mg/liter were attained following activated sludge treatment without active carbon, compared to values of 50-128 mg/liter for fresh active carbon addition at 100 mg/liter of wastewater. A visible improvement in effluent clarity was achieved. During some experimental periods, normal operation of the biological treatment plant without carbon addition was impossible. To reduce the cost of treatment, an experimental carbon regeneration plant was constructed. The mixture of excess sludge, spent carbon and wastewater was collected, mechanically dewatered, and the carbon regenerated. Adequate reactivation was accomplished for several cycles by desorption with stream at 150-200 degrees C, but then a more rigorous treatment was required, comprising desorption at higher temperatures and reactivation in an inert gas (fluidized sand bed) at temperatures above 800 degrees C. (Carroll-FRC)
W82-04283

COMBINATION OF MACROPOROUS RESINS AND ACTIVATED CARBON IN ADVANCED WASTEWATER TREATMENT. (KOMBINATION VON MAKROPOROSEN ADSORBERHARZEN MIT AKTIVKOHLE ZUR WEITERGEHENDEN ABWASSERREINIGUNG),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Ruffer, and T. Slomka.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 176-180, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Resins, Municipal wastewaters, Organic compounds, Recycling, Regeneration, Filtration, Total organic carbon, *Macroporous resins.

Combining weakly basic ion exchange resins and active carbon for treatment of municipal wastewaters would reduce costs by prolonging carbon life and increasing adsorber performance. A test system was constructed comprising multilayer (gravel/sand/anthracite) filtration, macroporous resin adsorption, and activated carbon adsorption, with the possibility of removing samples for analysis after each treatment stage. A high-quality regenerable carbon produced more complete removal of organic materials than an inexpensive, disposable carbon. Using a biologically pretreated feed water, the initial TOC 26.4 mg/l decreased to 20.6 g/liter following filtration, 11.8 mg/liter following resin adsorption, and 6.14 mg/l after treatment with the regenerable carbon. Effluent quality remained constant up to the breakthrough point of the column, which was reached after 6000 bed volumes had passed through. Subsequent chlorination gave water of excellent quality for industrial use. The problem of disposal and cost of the regenerant solution had previously interfered with practical use of resin adsorption. The regeneration eluate should not be discarded, as it can be reused up to 8 times. Eluate volume for disposal was reduced to about 1 cu m/10,000 cu m of wastewater treated by allowing a diffusion interval, i.e., allowing the regenerant to remain in contact with the resin for a few hours early in the regeneration process. The most heavily contaminated regenerant fractions were discharged to the biological water treatment plant, and the remainder reused. (Carroll-FRC)
W82-04284

CHRYSLER UPGRADES OILY WASTES TREATMENT IN KOKOMO,
Chrysler Corp., Kokomo, IN.
B. D. Harlow, and T. M. Doran.
Industrial Wastes, Vol 27, No 6, p 24-27, November/December 1981. 2 Fig, 2 Tab.

Descriptors: *Industrial wastewater, *Oily water, *Wastewater treatment, Freon, *Separation techniques, *Metal-finishing wastes, Chrysler Corporation.

The Chrysler Corporation plant in Kokomo, Indiana, has upgraded its waste treatment plant to reduce the concentration of freon extractable compounds to less than 50 mg per liter prior to discharge into the city sewer system. The facility makes and assembles cast aluminum transmission parts. These processes require large quantities of oil. Problems with the original treatment facilities were inadequate batch tank capacity, inefficient chemical feed system, only a single flotation unit, necessity for a separate low grade oil processing system, and a large volume of water. Modifications included use of an emulsion breaker, addition of a batch treatment tank, oil/water separator tank, oil pre-heat tanks, and filtered oil tank; pH adjustment; and elimination of a flotation unit and oil cookers. Reclaimed oil is sent elsewhere for additional refining or storage on-site. current effluent freon extractables are 21 mg per liter compared with 80 mg per liter in 1976. The volume of liquid treated has been reduced from 10.8 million gal per month to 7.6 gal per month, alum dose from 602 to 58 mg per liter, polymer dose from 9.7 to 1 mg per liter, chemical costs from $11,573 to $2,437 per month, and cost per 1000 gal from $1.07 to 33 cents. No waste oils are generated by the modified process, whereas 10,000 gal per week were formerly produced for disposal at 10 cents per gal. (Cassar-FRC)
W82-04285

IMPACT OF PHOSPHORUS REMOVAL AT THE DANBURY, CONNECTICUT SEWAGE TREATMENT PLANT ON WATER QUALITY IN LAKE LILLINONAH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water, Air, and Soil Pollution, Vol 16, No 4, p 511-531, 1981. 12 Fig, 5 Tab, 14 Ref.

Descriptors: *Water quality, *Phosphorus removal, *Water treatment facilities, Eutrophication, Lakes, Rivers, *Lake Lillinonah, Housatonic River, Filtration, *Danbury, Connecticut, *Wastewater treatment, Lake restoration.

This paper presents an independent assessment of the results of the FMC Corporation's limnological surveys made of Lake Lillinonah and Lake Zoar, an impoundment just downstream from Lake Lillinonah, and their major tributaries during the summers of 1976 and 1977. The surveys provide data which should help evaluate the effect of phosphorus removal at the Danbury wastewater treatment plant on water quality in the two lakes. The data revealed an apparent improvement in Lake Lillinonah water quality between the two years which might be related to phosphorus removal at the Danbury treatment plant. Phosphorus load was reduced from 13600 to 6700 kg/year in 1976 and 1977, respectively. The flows of the Housatonic River in 1976 and 1977 were also dissimilar: in 1977 about twice as much water entered Lake Lillinonah as in the former year. The eutrophication study results were used to estimate the impact of flow and altered phosphorus loads on Lake Lillinonah's eutrophication-related water quality. The average planktonic algal chlorophyll concentration would have been reduced from 35 to 30 micrograms/liter if the flows of the Housatonic River were to have been the same during the two years of the study. (Baker-FRC)
W82-04298

DESIGN MODELS FOR ADSOPRTION SYSTEMS IN WASTEWATER TREATMENT,
Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay.
Journal of Chemical Technology and Biotechnology, Vol 13, No 2, p 717-731, 1981. 12 Fig, 69 Ref.

Descriptors: *Design criteria, *Water treatment facilities, Wastewater treatment, Mathematical models, Model studies, Simulation, Adsorption, Industrial wastes, Effluents.

Various methods of solid-liquid contacting in adsorption systems have been considered. High mass-transfer rates are obtained in fluidized bed systems, and small adsorbent particles may be used, giving a large external surface area for adsoprtion. The control of such systems is more difficult than of a fixed-bed column, and there is a lack of flexibility in operation. Fixed-bed adsorbers are most widely used, and the effluent continuously comes into contact with fresh adsorbent. Therefore the driving force to each equilibrium is high. In batch processes a relatively long contact time is needed to reach equilibrium and a further solid-liquid separation stage is needed at the end of the process. The selection of the correct adsorbent, the method of contacting and the regeneration system determine the economics of adsorption systems. Various methods of designing adsorption systems for wastewater treatment have been considered. The design of the reactivation unit is considered, and the technique of minimizing the cost of adsorption plants is discussed. It is usually wise in the design of wastewater treatment plants to allow some overdesign to account for certain factors, including flow rate surges, changes in feed concentration, increases in throughput requirements or increased levels of effluent quality, and for decreased adsorbent performance due to numerous reactivations. (Baker-FRC)
W82-04300

WATER TREATMENT AT HOMESTAKE'S BULLDOG MOUNTAIN OPERATION,
Homestake Mining Co., Creede, CO.
J. L. Young, and R. A. Bohling.
Mining Engineering, Vol 33, No 12, p 1689-1691, December, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Mine drainage, *Heavy metals, *Water quality standards, Hydrogen ion concentration, Mine wastes, Silver, Lead, Metals, Wastewater facilities, Aeration, Clarification, Filtration, Sand filters, *Colorado.

In 1977, a mine water treatment plant was constructed for Homestake's Bulldog Mountain silver and lead mines to keep discharge waters in line with National Pollutant Discharge Elimination System regulations. In 1980, construction began on a wastewater treatment plant. During treatment, mine discharge is first metered and then passed to the aeration stage. Metals are precipitated in a clarifier as hydroxides at pH 9.5-10.0 regulated by lime solution. The clarified effluent is sent to a splitter, where part of the stream may be treated by sand filtration. Sulfuric acid is used to make final pH adjustments to 6.0-9.0. Initial plant start-up problems were encountered with maintaining clarifier and final pH, effective lime pumping, and sludge removal. Most control problems were solved by a programmable Taylor 1380R adaptable gain controller. Daily assays from the plant show good compliance of discharge with permit parameters. High copper levels are occassionally encountered and are treated with hydrogen perioxide. Tests are in progress to study the feasibility of using O2 in place of sulfuric acid for effluent pH adjustment. (Geiger-FRC)
W82-04311

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,
Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
W. D. Givens, F. K. Marotte, and C. T. Zeien.
Industrial Water Engineering, Vol 18, No 5 p 20-25, September/October, 1981. 8 Fig.

Descriptors: *Cooling water, *Powerplants, *Water reuse, Water treatment, *Wastewater treatment, Water management, Water softening, Industrial wastewater, Algicides, Reverse osmosis, Evaporation, Ash, Solid waste disposal, Waste disposal, Water conservation, *Coal, Fuel, Water pollution prevention, Zero discharge, Colorado.

The Ray D. Nixon coal-fired power plant near Colorado Springs, Colorado, has successfully practiced zero-discharge water management since its opening in April 1980. The water comes from eight wells above a small brackish aquifer, which is

recharged from a nearby creek. Water softening by sodium-base ion exchange reduces the hardness. The treated water is stored in a 5.2 million gal steel reservoir until needed. Wastewater streams are equalized in a 10 million gal clay lined basin with 2 week detention time. Algae are controlled with simazine. The automated filtration system consists of three package units with capacities of 300 gpm each. Ferric chloride and a cationic polymer are used as flocculators. A 120,000 gal clear well provides filter backwash water and cushions flow changes. The remainder of the water treatment system consists of reverse osmosis, evaporators, decant basins, and evaporation ponds. (Cassar-FRC)
W82-04320

RECYCLING ALLOWS ZERO POWERPLANT WASTEWATER DISCHARGE,
B. B. Hall, and L. Stierwalt.
Industrial Water Engineering, Vol 18, No 5, p 26-30, September/October, 1981. 1 Fig, 5 Tab.

Descriptors: *Cooling water, *Powerplants, *Water reuse, *Wastewater treatment, Industrial wastewater, Water management, Ash, Solid waste disposal, *Waste disposal, Water conservation, Water pollution prevention, Clarifiers, Martin Drake Power Station, *Colorado Springs, Colorado, Zero discharge.

A zero discharge plant was designed for the coal-fired Martin Drake Power Station, Colorado Springs, Colorado, to comply with environmental regulations. A dual treatment system with limited interconnections was selected, one system to process ash transport water and the other to process cooling water blowdown. Fly ash and bottom ash are sent via the existing hydraulic transport system to new clarifiers for gavity settling. The ash transport water is reused for transporting more ash. Settled ash is trucked to a landfill. Cooling tower blowdown is treated with a cold lime-soda ash softening process to control Ca, Mg, and silica followed by clarification, filtration through dual sand-anthracite media, and pH adjustment. Sludge is added to the ash treatment process, and water is returned to the cooling system. (Cassar-FRC)
W82-04323

SHAKING DOWN A SOLIDS HANDLING SYSTEM,
Greater Lawrence Sanitary District, North Andover, MA.
E. Teittinen.
Water/Engineering and Management, Vol 129, No 1, p 45-46, January, 1982. 2 Fig.

Descriptors: *Wastewater facilities *Sludge solids, Treatment plants, *Water treatment facilities, Filters, Pumps, Clogging, Springs, Fibers, Industrial wastes, Textile mill wastes, Waste disposal, Solid wastes.

Problems which occurred during the start-up of a solids handling system in North Andover, Massachusetts are reviewed. Early problems were noted in the development of the vacuum filter operation; these were overcome. At the start, running the vacuum filters with only a primary sludge feed was trouble-free. This ended when activated sludge was generated and mixed with primary. The system's ability to keep pace with the solids being produced became severely limited, and an intensive diagnostic program was begun. Problems were identified in the spring gap and sprays, following which steps had to be taken to ensure that coil integrity would be maintained after they were refurbished. A final refinement in the vacuum filter operation was achieved when ferric chloride and lime were replaced with polymers as dewatering aids. Material handling had been simplified by converting an unused sodium hypochlorite storage tank to bulk polymer storage. In addition to labor savings, significant reductions were realized in processing chemical costs. While there was no reduction in cake solids content due to the conversion, there was a significant increase in volatile solids (65-75%) and a reduction in ash volume for disposal. (Baker-FRC)
W82-04338

DISSOLVED OXYGEN CONTENT MONITORING USING GAS PHASE OXYGEN ANALYSIS IN A HIGH PURITY OXYGEN ACTIVATED SLUDGE PLANT,
Yokohama Sewerage Bureau, Kawasaki (Japan).
Y. Kurokawa, Y. Nameda, Y. Itoh, T. Katoh, and R. Tanuma.
Water Science and Technology, Vol 13, No 9, p 293-298, 1981. 3 Fig, 3 Ref.

Descriptors: *Activated sludge process, *Oxygenation, *Monitoring, Dissolved oxygen, Wastewater treatment, Oxygen transfer, Aeration, *Kawasaki, *Japan.

Dissolved oxygen control in a high purity oxygen activated sludge plant was achieved by monitoring the partial oxygen pressure in the vapor phase and the water temperature. Values calculated from this procedure compared well with measured dissolved oxygen concentrations from April 17 to December 30 at the 1500 cu m per day Ikuta sewage treatment plant, Kawasaki, Japan. A dissolved oxygen rate of 20 mg per liter was found suitable for this plant. Further increases in dissolved oxygen levels did not consistently improve treated water quality. (Cassar-FRC)
W82-04344

A TREATMENT SYSTEM FOR AN ORGANIC CHEMICALS PLANT,
Allied Chemical Company, Danville, IL.
N. L. Lanter, and D. L. Hatfield.
Industrial Wastes, Vol 27, No 6, p 22-23, November/December, 1981. 1 Fig, 1 Tab.

Descriptors: *Chemical wastewater, *Organic compounds, *Chlorinated hydrocarbons, *Wastewater treatment, *Industrial wastewater, Carbon tetrachloride, Acidic water, Sodium hypochlorite, Sedimentation, Chemical wastewater.

The Allied Chemical Company plant at Danville, Illinois, treats six wastewater streams individually before combining them for suspended solids removal and discharge into the city sewer system. The basic process involves reaction of carbon tetrachloride with hydrofluoric acid, using the additional raw materials sulfuric acid, hydrochloric acid, hydrocarbons, finishing agents, sodium hydroxide, and heavy metals. The six wastewater streams are as follows: (1) weak sodium hypochlorite solution, (2) chlorocarbons and chlorofluorocarbons, (3) acidic water containing fluorocarbons, (4) colling tower and boiler blowdown, and (5) and (6) acidic water with up to 50% total suspended solids. Sanitary waste and stream (4) are discharged directly into the sewer. Noncontaminated storm water is transported off-site. Stream (1) treatment catalytically decomposes sodium hypochlorite into oxygen and chloride. Stream (2) treatment involves settling chlorocarbons and separation in a tank; Stream (3) is sent directly to the combined final treatment. The high solids (5) and (6) wastewaters are subjected to sedimentation in the containment vessels. Terminal combined treatment consists of two sedimentation steps and filtration followed by discharge into the sewer. (Cassar-FRC)
W82-04353

AMERICAN HOECHST UPGRADES A TREATMENT SYSTEM THROUGH AUTOMATION,
American Hoechst Corp., Leominister, MA.
V. M. DiTaranto, Jr.
Industrial Wastes, Vol 27, No 6, p 28, 31-33, November/December, 1981. 2 Fig, 2 Tab.

Descriptors: *Heavy metals, *Metal-finishing wastes, *Automation, *Sludge drying, *Wastewater treatment, Nickel, Copper, Zinc, American Hoechst Corporation, Industrial wastewater, Chemical wastewater, Electroplating.

Pretreatment of electroplating wastewater removes 96% total suspended solids, 97% nickel, and 98% zinc at the American Hoechst plastics manufacturing facility at Leominster, Massachusetts. The effluent is then combined with wastewater from the styrene polymerization process for further treatment. The system uses lime neutralization, ferric sulfate coagulation, flocculation, sedimentation, sludge dewatering, and effluent polishing. Influent and effluent metal levels (in mg per liter) average: Cu, 17.2 and 0.9; Ni, 19.2 and 2.4; and Zn, 56.4 and 1.3. Much of the system is automatically controlled, including start-up and shutdown, level control, pH control, sludge centrifugation, and monitoring. (Cassar-FRC)
W82-04354

OPERATIONAL PERFORMANCE OF AN RBC UNIT IN CONJUNCTION WITH A SEPTIC TANK,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
J. W. Atwater, and G. Bradshaw.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 477-483, December, 1981. 7 Fig, 11 Ref.

Descriptors: *Septic tanks, *Solids contact processes, *Primary wastewater treatment, Wastewater treatment, Rotating biological contactors, Biological treatment, Performance evaluation, Denitrification, Oxidation, Nitrogen removal, *British Columbia.

Data collected from the wastewater system operation at a 60-man prison camp near Agassiz, British Columbia, was analyzed. The system consisted of a rotating biological contactor in series with a septic tank for primary solids removal and sludge storage. A secondary clarifier sent sludge back to the septic tank for recycling. Chlorination and three days of lagooning were followed by discharge of effluent into a stream. An initial odor problem was solved by recycling effluent from the last stage of the contactor back to the septic tank. This system produced an effluent acceptable by federal guidelines, 20 mg per liter for BOD and 25 mg per liter for suspended solids. Effluent quality degenerated if solids were not removed from the septic tank within 12 months. Data suggest that the required surface area for rotating biological contactors operating with primary treatment by septic tanks is three times that using conventional primary treatment. Denitrification occurred concurrently with carbonaceous oxidation. (Cassar-FRC)
W82-04355

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATER--IV. CONCLUSIONS, DESIGN AND OPERATIONAL CONSIDERATIONS FOR ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
M. S. Gordon, D. J. Chapman, L. Y. Kawasaki, E. Tarifeno-Silva, and D. P. Yu.
Water Research, Vol 16, No 1, p 67-71, January, 1982. 10 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, Wastewater treatment, *Recycling, *Nutrients, Design criteria, Heavy metals, Metals, *Food chains, Fate of pollutants, Effluents, Bioaccumulation, Accumulation, Nutrient removal, Cultures, Algal growth, Algae, Scenedesmus, Cladocerans, Crustaceans, Fish, Daphnia, Chlorophyta, Shinrs, Fathead minnows, Carp.

This paper summarizes the results of three previous papers on growing food chains in secondary wastewater for the purposes of tertiary wastewater treatment in effluent which has been chlorinated, then dechlorinated. The food chains consisted of unicellular green algae, herbivorous cladocerans or fish, and carnivorous fish, followed in som cases by filamentous green algae. Aspects studied in the first three papers were nutrient uptake, biological productivity, and heavy metal accumulation. Some general conclusions are drawn in this paper. This process is feasible for reducing effluent nutrient loading and for growing usable crops of organisms in sunny, temperate regions. Batch cultures are reliable, but continuous cultures are not likely to be usable without pH control. A near-neutral pH will produce high densities of suspended algal cells, while absence of pH control will produce clumped cells for easy harvesting. These aquaculture operations are best suited to rural and suburban areas,

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where competition for land use is not too great. (Cassar-FRC)
W82-04369

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--III. UPTAKE OF DISSOLVED HEAVY METALS BY ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
E. Tarifeno-Silva, L. Y. Kawasaki, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 59-65, January, 1982. 9 Tab, 23 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, *Heavy metals, *Accumulation, *Nutrients, Fate of pollutants, *Food chains, Cultures, Wastewater treatment, Metals, *Recycling, Effluents, Bioaccumulation, Algae, Chlorophyta, Scenedesmus, Cladocerans, Daphnia, Fish, Notemigonus, Pimephales, Shiners, Fathead minnows.

Concentrations of 15 heavy metals (Ba, Cd, Co, Cr, Cu, Fe, Mn,Mo,Ni, Pb, Sn, Sr, Ti, V, Zn) accumulating in an algae algae-cladoceran-fish food chain growing in secondary wastewater effluent were reported. The food chain consisted of Scenedesmus (algae); Daphnia magna and Daphnia pulex (cladocerans); and Notemigonus crysoleucas and Pimephales promelas (fish). Concentration factors were higher in algae (500-30,000) than in Daphnia (30-6000) and fish (4-1600). The concentrations of metals found in algal cells depended on buffering and presence of ferrous sulfate. Relative abundances of metals in algae were substantially different from the abundances in effluent. Concentrations of metals in cladocerans were 2 to 50% of those in algal cells. Relative abundance differed between algae and Daphnia and between Daphnia magna and Daphnia pulex. Most elements were either equal in both species or higher in Daphnia magna than in Daphnia pulex. For 7 of 9 metals fish showed lower metal concentrations in muscles than the Daphnia they ate. Relative abundances of the metals differed between the two fish species. (Cassar-FRC)
W82-04370

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--I. NUTRIENT UPTAKE AND RELEASE BY ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
L. Y. Kawasaki, W. Tarifeno-Silva, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 37-49, January, 1982. 2 Fig, 8 Tab, 55 Ref.

Descriptors: *Tertiary wastewater treatment, *Nutrient removal, *Recycling, *Aquaculture, Wastewater treatment, Algal growth, Algal harvesting, Fish, Cladocerans, Algae, Chlorophyta, *Food chains, Nitrates, Phosphates, Effluents, Nitrogen removal, Phosphorus removal, Cultures, Scenedesmus, Cladophora, Ulothrix, Daphnia, Notemigonus crysoleucas, Pimephales promelas, Notropis lutrensis, Carp, Shiners, Fathead minnows, *Water reuse.

The nutrient (nitrate and phosphate) dynamics of each stage in artificial food chains was investigated in a secondary wastewater effluent for the purpose of producing a tertiary-treated effluent. Suitable organisms were Scenedesmus, a unicellular green alga; Cladophora and Ulothrix, filamentous green algae; Daphnia magna and Daphnia pulex, cladocerans; and Notemigonus crysoleucas, Pimephales promelas, and Notropis lutrensis, fish. Addition of 1 ppm ferrous iron and 5% carbon dioxide were required to provide good algal growth for the cladocerans' food supply. Nitrate and phosphate removals in buffered algal cultures were 78% and 55%, respectively; in unbuffered algal cultures, 30% and 98%, respectively. The high removal of phosphate in the unbuffered cultures was probably a result of precipitation of phosphate at the high pH levels. The cladocerans and fish returned ammonia and phosphate to the effluent. These were removed in the final stage by filamentous green algae. Continuous light conditions were more conducive to nutrient removal than a 12 hour light-12 hour dark cycle. Daily harvesting rates of 25-75% of culture volumes did not significantly affect nitrate removals in buffered algal cultures, but phosphate removals were inversely proportional to harvesting rates. (Cassar-FRC)
W82-04371

DESTABILIZATION OF BIOLOGICAL SOLIDS WITH FERRIC CHLORIDE,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. C. Chao, and T. M. Keinath.
Water Research, Vol 16, No 1, p 23-30, January, 1982. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Activated sludge process, *Coagulation, *Ferric chloride, Wastewater treatment, Flocculation, Suspended solids, Organic matter, Hydrogen ion concentration, Microorganisms.

A two-step pH control method is given for coagulating suspended biological solids produced during upsets in the activated sludge process. This situation is characterized by high levels of sludge pinpoint flocs and dispersed cells. In ferric chloride coagulation the flocs are readily removed at low dose levels, but the cells, only a small percentage of the total suspended solids, require a much higher dose of coagulant for complete removal. In the two-step method, ferric chloride is added quickly so that solution pH drops to 3-4. During this low pH period the ferric chloride is in soluble form, effectively sorbed by biological particles. After 20 sec mixing, the pH is adjusted to 5.0. Then the soluble ferric chloride species polymerizes, forming insoluble bridges more evenly sorbed by solids than those produced by the constant pH method. This method removed 13 mg per liter biological solids with 1 mg per liter ferric chloride, a 25% savings in chemical over the constant pH method. (Cassar-FRC)
W82-04373

ON THE MARGINAL COST OF WASTEWATER SERVICES,
President's Council of Economic Advisers, Washington, DC.
For primary bibliographic entry see Field 6C.
W82-04376

WASTEWATER DECHLORINATION STATE-OF-THE-ART FIELD SURVEY AND PILOT STUDIES,
Los Angeles County Sanitation Districts, Whittier, CA.
C. Chen, and H. B. Gan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102336, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-169, October 1981. 5 p, 6 Fig. 14-12-150, 68-03-2745.

Descriptors: *Wastewater treatment, *Dechlorination, *Activated carbon, *Sulfur dioxide, *Holding tanks, *Cost analysis, Residual chlorine, Coliforms, Effluents, Aeration, Bacteria, chemical treatment, Disinfection, Los Angeles county, California.

A study of dechlorination was conducted in the County Sanitation Districts of Los Angeles County to determine the utility and efficiency of the sulfur dioxide method and to provide a cost-effective comparison of sulfur dioxide and two other methods of dechlorination, namely, activated carbon and holding tank processes. Pilot-scale testing indicated that no degradation of physical and chemical water quality occurred in the dechlorinated effluents from any of the three dechlorination processes investigated. However, a one to two order of magnitude increase in total coliform density in the 10-minute samples following cechlorination was commonly observed among the three dechlorination processes. The increase seemed to originate from contamination by the existing microorganism communities in the dechlorinated effluent rather than from the reactivation of injured bacterial cells. A field survey involved the canvassing of 55 operating plants in California by mail, telephone, and site visits to selected facilities. The feed forward method of sulfur dioxide dosage control with signals received from both a flow and residual chlorine controller appeared to be the most commonly employed method. Although overdosing of sulfur dioxide was frequently necessary to meet the residual chlorine discharge standards, most installations found pH adjustment and reaeration of the dechlorinated effluent unnecessary. Process cost estimates based on the field survey and pilot-plant study have been prepared for all three dechlorination processes. The sulfur dioxide process seems to be the most cost-effective method for dechlorination. (Moore-SRC)
W82-04392

PERFORMANCE OF ACTIVATED SLUDGE PROCESSES: RELIABILITY, STABILITY AND VARIABILITY,
Brown and Caldwell, Pasadena, CA.
S. Niku, E. D. Schroeder, G. Tchobanoglous, and F. J. Samaniego.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109604, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-227, December, 1981.11 p, 3 Fig, 6 Tab. R805097-01.

Descriptors: *Wastewater treatment, *Activated sludge process, *Effluents, *Statistical analysis, Standards, Variability, Reliability, Mathematical models, Biochemical oxygen demand, Suspended solids, Effluent variables.

Variations in the daily effluent quality of 43 activated sludge processes were examined. From an analysis of the data, it was found that the effluent variables are not distributed symmetrically, and generally their distributions are skewed further to the right than to the left of the most frequent value. The log-normal distribution was fond to fit the observed effluent biochemical oxygen demand (BOD) and suspended solids (SS) data most consistently. Using the lognormal distribution and a coefficient of reliability (COR), a probabilistic model and design tables and graphs have been developed for predicting achievable effluent BOD and SS concentrations. Mean constituent values are correlated to selected standards with the COR. The proposed model can be used in the design of a treatment process expected to perform at a certain reliability and/or to estimate the reliability of an operating treatment plant. Validity of the reliability model in prediction of effluent quality performance has been verified. The standard deviation was found to be the most appropriate indicator of stability. A standard deviation of 10 g/cu m was selected as stability cut-off point on the basis of a qualitative examination of the data. Plants with effluent values below 10 g/cu m are considered stable; plants with values greater than 10 g/cu m are considered unstable. No single variable or group of variables was found that could be used to characterize the variability of effluent quality for all plants in general. The appropriateness of effluent standards as they are currently stated was discussed, and the use of the geometric mean as a measure of central tendency of daily effluent quality data was recommended for setting discharge standards. (Moore-SRC)
W82-04394

SURVEY AND EVALUATION OF FINE BUBBLE DOME DIFFUSER AERATION EQUIPMENT,
Association of Metroplitan Sewerage Agencies, Washington, DC.
D. H. Houck, and A. G. Boon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105578, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-222, October, 1981. 8 p, 5 Tab. R806990.

Descriptors: *Aerators, *Wastewater treatment, *Oxygen transfer, *Activated sludge process, Maintenance, Cost analysis, Energy, Design criteria.

Aeration equipment employed in activated sludge service is usually the single largest energy consumer in a wastewater treatment plant. Because fine bubble aeration equipment has the potential for markedly higher oxygen transfer efficiencies than coarse bubble designs, its use is rapidly expanding in new or retrofitted treatment plants. In order to assess the long-term oxygen transfer performance, and operation and maintenance history of fine bubble dome diffuser aerators, 19 treatment plants were studied. Thirteen of the plants were in the United Kingdom, two in the Netherlands, and four in the U. S. As nearly as possible, data on influent and effluent wastewater characteristics, power demand, air supply, and process parameters were compiled for a 5-yr period. Maintenance personnel were interviewed to develop a summary of long-term operation and maintenance experience. Specific designs and plant equipment for aeration, air clearing, and diffuser maintenance were studied. Although this survey clearly shows the need for optimized design and operating control strategies to realize the full energy saving potential of this type of equipment, dome diffuser fine bubble aeration systems were providing relatively efficient, low-maintenance service in the plants visited. (Moore-SRC)
W82-04395

DEMONSTRATION PHYSICAL CHEMICAL SEWAGE TREATMENT PLANT UTILIZING BIOLOGICAL NITRIFICATION,
Municipal Environmental Research Lab., Cincinnati, OH.
J. F. Kreissl, and R. F. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101643, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-173, October, 1981. 7 p, 2 Fig, 2 Tab.

Descriptors: *Physicochemical treatment, *Biological wastewater treatment, *Nitrification, *Wastewater treatment, Domestic wastes, Phosphorus removal, Nitrogen removal, Effluent, Oxygen demand.

This demonstration project was conducted to show that wastewater could be treated in a physical-chemical wastewater treatment plant employing a biological intermediate stage for oxidation of nitrogenous material to produce a high quality effluent and provide different treatment levels to meet a variety of effluent requirements. The physical-chemical plant chosen was of a modular design employing high-rate processes which normally facilitate a relatively speedy installation, a minimum amount of lag time to produce the desired effluent quality, and ease of transport for relocation to other critical areas when needed. The plant was located in the drainage area of a planned residential development known as Beechgrove Village in Kentucky. The wastewater was domestic in nature with no commercial or industrial sources. The removals of BOD5, COD, total organic carbon and suspended solids were excellent. Phosphorus removal was also excellent but the nitrogen removal was rather low. Nitrification never properly developed during the course of the study, even though the nitrogen removals averaged 32%. Although the system produced a consistent, high quality effluent, its utility as a transportable system was only partially demonstrated and its viability as a treatment sequence could not be confirmed due to several design and operational problems. (Moore-SRC)
W82-04397

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,
California Dept. of Health Services, Berkeley.
E. Sepp, and P. Bao.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-100835, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-167, October, 1981. 5 p, 2 Fig, 2 Tab. S-803459.

Descriptors: *Chlorination, *Wastewater treatment, *Disinfection, *Effluents, *Residual chlorine, Coliforms, Toxicity, Pilot plants, Contact time, Mixing, Plug flow, Bacteria, Water pollution control.

Parallel wastewater effluent chlorination studies were done on a mobile optimized chlorination pilot system and the full-scale system at eight different treatment plants. Disinfection efficiency was measured by total coliform enumeration and chlorine residual tests. Parallel flow-through fish bioassays were also conducted at each location. The objectives of the study were as follows: achievement of adequate disinfection with minimum use of chlorine; reduction of chlorine-induced toxicity; and writing of a design manual. At 7 of the 8 plants studied the optimized pilot plant achieved an equivalent level of disinfection with significantly lower chlorine dosage, in some cases more than 50% lower, than the full-scale plants. The pilot plant chlorine residuals were also lower by the same proportions. The reasons for the better pilot plant results were rapid initial mixing, improved chlorine control, and plug flow contact. In most cases the bacterial survival ratio could be expressed as a function of the product of chlorine residual and contact time. There appeared to be, however, a limiting contact time to which this relationship applied. The degree of coliform reduction obtained during initial mixing appeared to be a function of chlorine residual. (Author's abstract)
W82-04399

HOURLY DIURNAL FLOW VARIATIONS IN PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES,
Weston (Roy F.), Inc., West Chester, PA.
W. H. Chesner, and M. Pai.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107954, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-218, October, 1981. 4 p, 2 Tab. 68-03-2775.

Descriptors: *Flow rate, *Wastewater, *Sewer systems, *Wastewater facilities, *Sewer infiltration, Pumps, Seasonal distribution, Industrial wastewater, *Diurnal distribution, Groundwater level, Design criteria, *Hydraulic design.

Flow variations are rarely addressed in the design of wastewater treatment plants. A survey of 39 sanitary sewer collection systems was undertaken to determine the magnitude of hourly peak flows and to identify the collection system parameters that were most influential in affecting the observed peaks. Significant collection system parameters identified included industrial contribution, average age of the collection system, depth to groundwater, and low-lift, pre-plant pumping stations. Collection systems with industrial or institutional flow contributions greater than 40% were found consistently to have higher daily peak flows than those below 40%. Industrial flows can also be seasonal, with flows during the industrial season resulting in higher peaking factors. Peak flow hours of the day tend to occur at earlier hours in industry-dominated systems. Nonindustrial collection systems with an average age greater than 25 years and high groundwater tables are more susceptible to infiltration, and exhibit higher peaking factors during the spring or infiltration season. The mean average hourly peak flow for nonindustrial systems, excluding inflow, was found to be 1.23 times the annual average daily flow. As collection system flow rate increases, variations around the mean value decrease. Instantaneous maximum peaking factors for low-lit, pump-dominated systems ranged from 1.3 to 4.7, and the minimum instantaneous flow factors varied from 0 to 0.8. (Moore-SRC)
W82-04402

EVALUATION OF ON-SITE WASTEWATER TREATMENT AND DISPOSAL OPTIONS,
Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from National Technical Information Service, Springfield, VA 22161 as PB82-101635, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-178, October, 1981. 5 p,1 Tab. 68-03-2627.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Domestic wastes, *On-site systems, *Wastewater management, Literature review, Disinfection, Land disposal, Biological treatment, Physicochemical treatment, Cost analysis, Environmental effects, Soil properties.

A literature review of published and unpublished data was conducted to identify conceivable on-site systems, including wastewater manipulation, treatment, and disposal options. Wastewater manipulation options included flow reduction, wasteload reduction, and waste segregation. Treatment options included disinfection and biological and phyical/chemical methods. Disposal options included air, soil, and surface water methods and practical combinations. Both tested and untested systems were identified, and combinations of the various components were developed. An equipment inventory was then performed to determine the availability of hardware for the systems, and system components were identified. Data on engineering, economic, and environmental acceptability characteristics were collected. These systems were evaluated on the basis of performance, operation and maintenance, environmental acceptability, and total annual cost for 15 specific site conditions. Site conditions were defined by soil percolation rate, soil depth, slope, available land area, direct discharge effluent requirements, and net evaporation. Where site conditions are appropriate (conventional septic tank-soil absorption systems) were found to be the least-cost and top-ranked method of on-site wastewater treatment and disposal. Under other conditions, systems incorporating other methods of disposal, such as soil disposal with modified distribution, mounds, evapotranspiration, irrigation, evaporation, or direct discharge, are appropriate. A septic tank normally provides adequate pretreatment for most of these disposal methods. Where irrigation or surface discharge disposal is used, additional treatment, such as that provided by an intermittent sand filter and iodine disinfection, may be required. Use of low pressure membrane filtration where high quality effluent is required also appears promising, based on very limited operating experience.
W82-04404

PRODUCTION ENGINEERING AND MARKETING ANALYSIS OF THE ROTATING DISK EVAPORATOR,
Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101676, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-179, October, 1981. 4 p, 1 Fig, 5 Tab. 68-03-2738.

Descriptors: *Wastewater treatment, *On-site systems, *Rotating disk evaporators, *Cost analysis, *Domestic wastes, *Marketing, Climates, Evaporators, Economic aspects, Wastewater disposal.

Recent research into the on-site, mechanical evaporation of wastewater from single family homes revealed that a rotating disk evaporator (RDE) could function in an non-discharging mode. Such a device has potential use where site limitations preclude conventional methods for on-site disposal. A marketing analysis of the RDE defined the market potential, developed a practical design, estimated production and installation costs, and refined market estimates based on cost comparisons. A small unit suitable for only the most favorable climates would have an FOB factory selling price of about $10,000 if fabricated with aluminum disks. Distribution costs and freight will amount to about $3,300. An additional $8,000 is required for installation (including a storage tank), resulting in a total capital cost of about $22,000. Including amortized capital costs, and operating and maintenance costs, an RDE system would treat household wastewater for about 3.4 cents/gallon. Because of these high

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costs, the potential RDE market is quite small. It is limited to very expensive homes, second homes with no winter occupancy, and high cash-flow, low sewage-flow commercial establishments. Furthermore, unfavorable climatic conditions eliminate much of the nation from consideration. It is unlikely that manufacturers of RDE systems would collectively generate national sales of 100 units/year. (Moore-SRC)
W82-04405

TREATABILITY STUDIES OF PESTICIDE MANUFACTURING WASTEWATERS,
Research Triangle Inst., Research Triangle Park, NC.
R. Zweidinger, E. Monnig, L. Little, R. Batten, and D. Liverman.
Environmental Protection Agency Project Summary EPA-600/S2-80-077, December, 1981. 4 p, 1 Fig, 3 Ref.

Descriptors: *Pesticides, *Industrial wastes, *Wastewater treatment, *Biological wastewater treatment, Activated sludge process, Fungicides, Herbicides, Insecticides, Carbamate pesticides, Biodegradation, Nitrification.

Laboratory and pilot studies of the treatability of pesticide manufacturing wastewaters were conducted in a project designed to investigate the suitability of individual pesticide manufacturing wastewaters for discharge to biological treatment systems, whether publicly owned treatment works or on-site systems. The pesticides studied were carbaryl, dinoseb, atrazine, dazomet, glyphosate, and an ethylenebisdithiocarbamate fungicide. The approach taken with each pesticide manufacturing wastewater was prioritized; that is, less costly, more available methods of treatment were investigated. The preferred method of treatment was assumed to be biological. Both carbaryl manufacturing wastewater, when mixed 1 part in 9 with muicipal wastewater, and carbaryl itself, spiked at 10 mg/l in municipal wastewater, appear suitable for biological treatment by acclimated systems if additional provision is made for removing ammonia in the effluents from the treatment system. The effluent from the manufacture of dinoseb and atrazine proved suitable for a treatment system involving preliminary activated carbon filtration to remove the herbicide, followed by biological treatment to reduce oxygen demand exerted by solvents and other organic compounds. It is recommended that dazomet wastewater be diluted to at least 1:1000 in municipal wastewater to minimize the negative effects on the nitrification of during the activated sludge treatment process. Biological treatment significantly reduced the toxicity of hlyphosate effluents, but hlyphosate itself showed only partial reduction with treatment (38 to 45%). The presence of ethylenebisdithiocarbamate fungicide manufacturing wastewater strongly inhibits nitrification in activated sludge units. Biological treatment decreased, but failed to eliminate, the amount of ethylenethiourea in the wastewaters. (Moore-SRC)
W82-04406

TREATMENT OF SULFITE EVAPORATION CONDENSATE WITH AN ANAEROBIC REACTOR,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, J. F. Ferguson, and M. E. Buggins.
In: Proceedings TAPPI Environmental Conference, 1981, TAPPI Press, Atlanta, Georgia, p 307-316. 6 Fig, 7 Tab, 7 Ref.

Descriptors: *Anaerobic treatment, Methane fermentation, Sulfite evaporator condensate, *Wastewater treatment, *Organic wastes, Sulfur compounds, Toxicity.

A study has been underway since 1979 evaluating the use of submerged anaerobic reactors to treat sulfite evaporator condensate (SEC). Both SEC from a calcium bisulfite mill and a synthetic SEC have been treated at an organic loading of 16 kg COD/m3.d and a detention time of seven hours, achieving 79% to 90% reduction in COD. A yield coefficient of 0.09 gr cells/gr COD removed has been calculated, and the balance of the removed COD is stoichiometrically converted to CH4. Toxicity from sulfur compounds, furfural or trace organics have not been a problem. Partial neutralization of the feed is necessary, as are additions of nitrogen, phosphorus and some trace nutrients. The process produces methane with a significant energy value. In addition, when used as pretreatment, it reduces the energy needed for aerobic treatment.
W82-04419

DEVELOPING AN EFFECTIVE MAINTENANCE PROGRAM PART A: EVALUATION,
Morris Forman Wastewater Treatment Plant, Louisville, KY.
G. R. Freiberg, and W. B. Thompson.
Water/Engineering and Management, Vol 129, No 1, p 30-33, January, 1980. 4 Fig.

Descriptors: *Maintenance, *Wastewater treatment facilities, Maintenance costs, Water treatment facilities, Planning, Management, *Louisville, Kentucky.

Many wastewater treatment facilities have a common problem of spending too much time keeping things running, and not enough time searching for ways to improve operational efficiency. The wastewater treatment plant in Louisville, Kentucky was used to develop an evaluation and implementation procedure for the establishment or upgrading of maintenance systems. The focus of the study was primarily on preventive maintenance, but water and wastewater managers and engineers should find the approach applicable to most maintenance activities. The strengths and weaknesses of each functional area were examined. One major problem which was exposed by this procedure was a substantial spread between estimated and actual costs. Reasons for this appeared to be that either the work was improperly estimated, or workers took too much time and used too much material to complete the task. A review of the existing work order procedure led to a new, more clearly defined set of instructions. Corrective and major maintenance scheduling and planning procedures proved to be ineffective. District-wide accounting and spare parts inventory procedures were included in the study because of their indirect, but critical, effect on the entire maintenance program. The purpose of any maintenance management system is to obtain reliable, efficient, cost-effective service from the equipment. Preventive maintenance is seen as just one element of any comprehensive program. (Baker-FRC)
W82-04447

TERMINAL REACTIONS IN THE ANAEROBIC DIGESTION OF ANIMAL WASTE,
Research Council of Alberta, Edmonton.
D. R. Boone.
Applied and Environmental Microbiology, Vol 43, No 1, p 57-64, 1982. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Anaerobic digestion, *Animal wastes, Organic matter, Biological treatment, *Wastewater treatment, Digestion, Biodegradation.

The terminal reactions of anaerobic digestion were examined to determine whether they are rate limiting. Acetate degradation was measured in digestors which were fed animal waste and in digestors fed animal waste with ultimate methanogenic substrates added continuously to the fermentation. The continuous pumping of acetic acid into the digestor caused an increase in acetate concentration in the effluent which was proportional to the increase in total acetate production, biological production plus amount pumped in. Propionate concentration also increased, perhaps due to product inhibition of propionate-degrading bacteria by the higher levels of acetic acid or due to increased propionate production by fermentative bacteria. When H2/CO2 was the added substrate, there were occasional instabilities in the fermentation immediately after increases in addition rate. The data allow the hypothesis that abrupt changes in digestor influent substrates, which cause a rapid increase in hydrogen production by hydrogen-producing microflora, could create instabilities, causing digestor failure. Digestors with added acetate or H2/CO2 converted at least 95% of the added substrates stoichiometrically to methane, assuming gas production from the animal waste was the same as in controls with no added substrates. Also, volatile solids destruction was similar in the presence and absence of added substrates, suggesting that fermentation of animal waste was not significantly affected by the added load on the methanogenic bacteria. Acetate levels in the digestor with added H2/CO2 were higher, apparently due to both increased acetate production and inhibition of acetate dissimilation. Increases in H2 addition caused temporary instabilities in the fermentation, whereas increases in acetate addition did not. (Baker-FRC)
W82-04454

BIODEGRADATION OF GLYCIDOL AND GLYCIDYL NITRATE,
Army Natick Research and Development Labs., MA.
D. L. Kaplan, J. H. Cornell, and A. M. Kaplan.
Applied and Environmental Microbiology, Vol 43, No 1, p 144-150, 1982. 7 Fig, 13 Ref.

Descriptors: *Nitrates, *Biodegradation, *Organic compounds, *Wastewater treatment, Chemical reactions, Industrial wastes, Biological treatment, Biological wastewater treatment, Nitroglycerine, Mutagens, *Glycidol.

The fate of glycidol and glycidyl nitrate was examined under exposure to microbial activity in order to indicate the feasibility of a biological approach to the decomposition of glycerol trinitrate chemical reaction products. The desensitization of glycerol trinitrate containing waste streams with calcium hydroxide produces the expoxides, glycidol and glycidyl nitrate. Epoxide rings of both compounds are unstable to heat in aqueous solutions. They open to form glycerol 1-mononitrate and presumably glycerol. Microbial activity accelerates these transformations. Glycerol 1-mononitrate was slowly denitrated to form glycerol. Glycidol and glycidyl nitrate caused base pair substitutions in the Ames test for mutagenicity, whereas glycerol 1-mononitrate tests were negative. Biological treatment causes a loss of the mutagenic activity. (Baker-FRC)
W82-04456

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
For primary bibliographic entry see Field 5B.
W82-04465

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,
Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
P. Wierich, and P. Gerike.
Ecotoxicology and Environmental Safety, Vol 5, No 2, p 161-170, 1981. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated sludge process, *Fate of pollutants, Organic compounds, Degradation, Biodegradation, Model studies, Retention time.

A mathematical model was developed to describe the fate of a compound in the activated sludge stage of sewage treatment plants. The compounds under consideration were soluble, nonbiodegradable, and strongly adsorbing. It was concluded that high adsorption in a batch test did not guarantee efficient elimination in a continuous flow activatd sludge process. The effluent concentration reached a limiting value dependent on adsorption constant of the sludge and the surplus sludge wasteage rate. The retention time of the adsorbate exceeded the mean retention time of the sewage and increased with increasing adsorption constant. The maximum

load of the adsorbent on the sludge was lower than the maximum capacity indicated by static batch tests, but it was higher than the influent concentration. The model described in this paper permitted calculation of a base value above which elimination in activated sludge tests was due to biodegradation and not just adsorption. (Cassar-FRC)
W82-04477

MUNICIPAL SEWAGE TREATMENT - SOME RECENT DEVELOPMENTS,
J. M. Sidwick.
Effluent and Water Treatment Journal, Vol 21, No 11, p 501, 503, 505-507, November, 1981. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, Reviews, Sedimentation, Filtration, Activated sludge process, Nitrification, Dissolved oxygen, Anaerobic conditions, Aeronic conditions, Anaerobic digestion, Computers, Automation, *Wastewater management.

Recent developments in the municipal sewage treatment field are discussed. The two most significant trends in primary sedimentation are the increasing use of chemical precipitation and a move toward reducing retention time. Chemical precipitation is being used primarily to remove phosphorus from sewage. Biological filtration has recently been connected with serious odor complications. Part of the problem seems to be the inability of a high rate filter to supply sufficient oxygen to maintain an adequately aerobic biomass, with the consequent development of anaerobic degradation products which escape from the filter aerially or with the wasted sludge. In the conventional activated sludge system the most important new developments relate to the use of this process for nitrogen removal. The chief attraction of biological denitrification is that the nitrogen is completely removed from the system as nitrogen gas without causing atmospheric pollution or a liquor concentrate. Two of the most important recent developments from conventional activated sludge treatment are the use of oxygen-enriched air and the deep shaft process. Biological fluidized beds have only very recently been considered for wastewater treatment. The principle of the fluidized beds is that mixed microbial cultures associated with wastewater have excellent adhesion characteristics. The value of anaerobic treatment has been appreciated for many years, but its application has largely been restricted to sludges and a few particularly strong biodegradable organic industrial effluents. The long retention periods needed for this process have tended to make it costly, and effluents have not been of high quality. Recent advances in the area of instrumentation for automation and control are briefly mentioned. (Baker-FRC)
W82-04528

LABORATORY EXPERIMENTS ON THE PHYSICO-CHEMICAL TREATMENT OF MEAT PROCESSING EFFLUENTS,
Research Inst. for Water Resources Development, Budapest (Hungary).
I. Tookos.
Effluent and Water Treatment Journal, Vol 21, No 11, p 493-500, November, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Meat processing industry, *Wastewater treatment, Effluents, Industrial wastes, Chemical coagulation, Separation techniques, Particle size, Colloids, Dissolved organic matter, Chemical engineering, Reviews, Bentonite, *Chemical treatment.

Effluents produced in the course of meat processing operations are highly detrimental, rich in coarse, floating, suspended and dissolved organic pollutants, and have high oxygen demands and unpleasant odors. Intensive mechanical primary treatment processes are effective in removing only coarse pollutants larger than 1-2 mm diameter, but the effluent is still very highly polluted. The physico-chemical treatment of wastewaters produced during the slaughtering and processing of poultry and meat is reviewed. The amount of pollutants removed was found to increase in a linear proportion with the strength of the wastewater treated. A relatively constant treatment efficiency can be expected. Evidently, the same close correlation exists between the raw wastewater and the treated effluent as well. In the case of wastewaters containing particulate matter not larger than 1-2 mm in size, laboratory studies demonstrated that the amount of colloidal substance precipitated did not depend on whether the pollutant was present in suspended form, or in a state which may be regarded as dissolved from the viewpoint of treatment technology. The optimal range of chemical feed rate determined by the laboratory provided no more than preliminary guidance. Higher feed rates may be needed in the interests of precipitate separation if the stability of the resulting sludge is poor. Bentonites alone were ineffective in precipitating colloidal proteins. Results obtained with sulfonic acid were poorer than had been expected. This was due to the carbohydrate content of the coagulant used in the study. The precipitate formed was highly unstable and impossible to remove by sedimentation. (Baker-FRC)
W82-04532

MICROBIOLOGY OF ANAEROBIC DIGESTORS FOR WASTEWATER PURIFICATION. (MICROBIOLOGIE DES DIGESTEURS ANAEROBIES DE L'EPURATION DES EAUX RESIDUAIRES),
Institut National de la Recherche Agronomique, Villeneuve-d' Ascq (France). Station de Technologie Alimentaire.
J. P. Touzel, E. Samain, G. Albagnac, and J. N. Morfaux.
Industries Alimentaires et Agricoles, Vol 98, No 10, p 845-847, 1981. 8 Fig, 3 Tab, 28 Ref. English Summary.

Descriptors: *Bacterial analysis, *Wastewater treatment, *Anaerobic digestion, Microbiological studies, Metabolism, Methane, *Food processing industry, Industrial wastewaters, Organic compounds, Hydrogen.

Detailed information concerning the biochemical characteristics of microbial populations employed in anaerobic digestion aid in optimization of the processes. Studies were performed on laboratory methane digesters treating food processing wastewaters, using recently developed techniques for isolating and growing strictly anaerobic bacteria. The pilot-scale digester was originally inoculated with municipal digester sludge. Media used for enumeration of the total flora and the lactate, propionate and acetate utilizing flora included an all-synthetic reference medium, a rumen fluid medium, a medium based on digester fluid, a medium based on the fluid from the digester from which the flora was taken, and fluid from a municipal digester. The anaerobic precautions employed were adequate to protect the oxygen-sensitive organisms. The predominant bacteria in the total flora were slow growing. The all-synthetic medium seemed to be the medium of choice for total flora enumeration. Presumptive identification was made of the lactate-utilizing strains, the presence of which indicates that the digestion of sugars proceeds through a lactate phase. Acetate enrichment cultures were set up to ascertain the importance of acetate as an intermediate in sugar digestion under the test conditions. After six transfers, bacteria of two principal morphological types were demonstrated: an elongated filament and a sarcina, which were tentatively identified with recently described strains. In propionate enrichment cultures, after four transfers, consumption of propionate and formation of methane were noted. Microscopic observation at this stage revealed the presence of a filamentous bacterium analogous to that obtained on acetate enrichment. Previous studies have shown that degradation of acetate and propionate does not take place in the presence of hydrogen. Hydrogen is therefore being efficiently eliminated from this medium by the methanogenic bacteria. (Carroll-FRC)
W82-04544

INCREASING WASTEWATER TREATMENT EFFICIENCY (UBER DIE ERHOHUNG DES WIRKUNGSGRADES DER ABWASSERREINIGUNG),
P. Benedek.
GWF-Wasser/Abwasser, Vol 122, No 12, p 572-581, 1981. 6 Fig, 10 Tab, 37 Ref. English Summary.

Descriptors: *Wastewater treatment, *Activated sludge process, *Cost effectiveness, Activated carbon, Lake Balaton, *Hungary, Chemical coagulation, Aluminum sulfate, Phosphorus removal, Heavy metals, Organic compounds, Sand filtration, Technology.

In recent years VITUKI, the central research institute of the Hungarian water agency, performed laboratory, pilot and full-scale studies on improvements in wastewater treatment technology. Operating data, cost analyses, and the possibility of process combinations are reported. Heavy metal removal following filtration was found to be poorer in biologically treated wastewater than in the raw wastewater, apparently due to complexation by degradation products. Therefore maximal heavy metal removal prior to biological treatment is important. Providing a mixing pond, prior to the preclarifier, in which the wastewater remains for a few minutes in contact with raw sludge recycled from the preclarifier at the rate of 10-20% would allow precipitation of metals by the sulfides present in the raw sludge. Addition of powdered activated carbon during the activated sludge process was shown to enhance refractory organics removal. Phosphorus elimination, especially important in the case of the Lake Balaton water supply, was accomplished by addition of iron or aluminum sulfate, or with a combination of activated bentonite, aluminum sulfate and polyelectrolytes. Sand filtration guidelines are currently being optimized. Cost comparisons for different combinations of treatment processes showed that the activated sludge process with activated carbon provides greatest cost effectiveness for small and medium sized wastewater treatment plants and can easily be combined with phosphate precipitation by aluminum sulfate. (Carroll-FRC)
W82-04545

THE IMPORTANCE OF THE SOLIDS CONTENT OF THE SLUDGE IN ANAEROBIC ALKALINE DIGESTION (DIE BEDEUTUNG DES FESTSTOFFGEHALTS BEI DER SCHLAMMFAULUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergueteund Abfallwirtschaft.
H. Kapp.
Wasserwirtschaft, Vol 71, No 11, p 319-322, 1981. 3 Fig, 6 Ref. English Summary.

Descriptors: *Mathematical studies, *Anaerobic digestion, *Wastewater treatment, Organic compounds, Sewage gas, Energy conservation, Sludge solids.

Anaerobic digestion has the advantages over aerobic digestion for sewage treatment of lower energy costs (the air supply accounts for 80% of the total energy requirement in an aerobic sewage treatment plant) and production of an off gas usable for heating. Disadvantages include the lability of the process and greater construction costs. A simple equation was developed for assessing the degree of degradation of the organic matter and thus the degree of anaerobic stabilization. Degradation rates of about 50% based on the organic matter supplied are considered normal for municipal sludges. The degree of sludge degradation was plotted against the loss on ignition of the original sludge, using the loss on ignition in the digester sludge as the parameter. This equation and graph should be used for evaluating the digestion results only over long periods (e.g., months), although this is also customary for other methods as well (solids balances). The method is applicable for operation with or without water withdrawal. A pseudo-three-dimensional plot was also developed, relating the initial solids contents, digested sludge solids content, and organic solids fraction in the sludge at different degrees of degradation. (Carroll-FRC)
W82-04549

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VARIATION OF SLUDGE VOLUME INDEX WITH ACTIVATED SLUDGE CHARACTERISTICS,
Georgia Inst. of Tech. Atlanta. School of Civil Engineering.
M. Sezgin.
Water Research, Vol 16, No 1, p 83-88, January, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Sludge volume index, *Microorgansims, *Settling velocity, Suspended solids, *Activated sludge, Flocculation, Wastewater treatment, *Wastewater facilities.

Activated sludge samples from two laboratory sources and 12 sewage plants were used to investigate the variation of sludge volume index (SVI) with the quantity of filamentous microorgansims and floc size at different suspended solids concentrations. For a suspended solids concentration range of 700-4800 mg per liter, the SVI increased sharply with filament length concentrations of over 10,000,000 microns per mg suspended solids. At filament length concentrations less than 10,000,000 microns per mg suspended solids, SVI was unaffected by filament length but increased with increasing mean floc size. A well-defined relationship between SVI and zone settling velocity (cm per min) was found at all suspended solids concentrations examined. Maximum attainable SVI varied from 1429 to 208 mg per liter over the suspended solids concentration range, 700-4800 mg per liter. The zone settling velocities corresponding to the maximum attainable SVI were 2 to 0 cm per sec. This relationship was independent of the source and type of sludge, domestic or industrial. (Cassar-FRC)
W82-04555

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W82-04557

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, E. D. Brill, Jr., and J. C. Liebman.
Water Resources Research, Vol 17, No 5, p 1339-1348, October, 1981. 8 Fig, 3 Tab, 11 Ref. OWRT A-082-ILL.

Descriptors: *Wastewater treatment, Planning, *Design criteria, Decision making, *Model studies, flow, Network design, *Wastewater facilities.

An extension was prepared of previous works dealing with the generation of single-period alternative solutions and the comparison of alternative regional plans using an impunted value analysis method. The primary purpose of the method is generation of multiperiod locations and facility expansion timings. The method is based on several simplifying assumptions. The solution procedure involves a branch and bound algorithm specifically developed for integrating a set of solutions obtained using the initial design flow with a set of solutions obtained using the terminal design flow. A method for comparing the generated multiperiod alternatives is also presented. The usefulness of the method is demonstrated with an example of a hypothetical regional wastewater system. A Fortran program was written to implement the method. Based on the simplifying assumptions, construction and operating and maintenance costs were reduced to functions of the initial and terminal design year flows, creating two decomposed problems. The two decomposed problems can be tied together using coupling constraints, and a coupled branch and bound process can be sued to obtain solutions. The method can generate many alternative plans besides the approximate least cost solution, and the imputed value incidence matrix can be provided. This approach represents a significant departure from conventional multiperiod public facility location analysis, and may be very useful for analyzing other water resources problems that include concave cost functions. (Baker-FRC)
W82-04562

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-04565

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James), Inc., Walnut Creek, CA.
L. L. Russell, C. Creson, and K. Conarroe.
Industrial Wastes, Vol 27, No 5, p 25-28, September/October, 1981. 3 Fig, 1 Tab. OWRT C-9416.

Descriptors: *Water reuse, *Food processing industry, *Industrial water, Water conservation, Dairy industry, Meat processing industry, Poultry, Sugar refining, Wastewater reclamation, *Wastewater renovation, Wastewater treatment.

An evaluation of 10,000 U.S. food processing plants revealed the potential for water reuse/recycling in this industry. Reuse is defined as treated wastewater recycled within the facility; recycle is defined as multiple use of wastewater within the facility. Time and economic constraints limit a practical implementation to water conservation and recycling for the present. By the year 2000 increased costs and decreased water supplies may necessitate water reuse in some segments of the industry. Health and safety must be carefully considered in water recycling. Fruit and vegetable processing with terminal heat processing are intrinsically safer than meat and poultry packing, where the product is served to the consumer without heat treatment. Small plants will find it less practical to recycle water than large facilities. Water reuse presents further concerns: trihalomethanes production, concentration of pesticides, and pathogenic organisms. Major water-using food industries are sugar refining, canning and preserving fruits and vegetables, grain milling, meat packing, poultry dressing, dairy product manufacture, and beverages. Water reuse facilities at the Snokist Growers fruit processing plant in Yakima, Washington, and the Sterling Poultry Processing Corp., Maryland, are described. (Cassar-FRC)
W82-04566

THE EFFECTS OF PH AND SUSPENDED SOLIDS IN THE REMOVAL OF ORGANICS FROM WATER AND WASTEWATERS BY THE ACTIVATED CARBON ADSORPTION PROCESS,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. J. Martin, and K. O. Iwugo.
Water Research, Vol 16, No 1, p 73-82, January, 1982. 13 Fig, 4 Tab, 32 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Hydrogen ion concentration, *Suspended solids, *Wastewater treatment, Adsorption, Organic matter, Kaolin, Chlorophenol, Cresol, Bromocresol green, Inorganic compounds, Biological treatment, Effluents, Municipal wastewater.

The effects of pH and inorganic and organic suspended solids concentrations on activated carbon adsorption of organic compounds in municipal wastewater and effluents were studied in the laboratory using actual effluents and model solutions. The adsorption capacity and adsorption rate of carbon for o-chlorophenol and o-cresol (molecular weghts, 100-130) and bromocresol green (molecular weight, 700) were not affected by the presence of inorganic suspended solids up to 200 mg per liter kaolin. At the 500 mg per liter level adsorption of only the largest molecule was slightly depressed. The organic suspended solids (mixed liquor volatile suspended solids) at 0-200 mg per liter slightly decreased adsorption rates for the three compounds. At the 200-500 mg per liter concentration of organic suspended solids, adsorption rates for the three molecules were significantly reduced. Adsorption capacity was reduced for the two smaller molecules but not for bromocresol green. In both model solutions and sewage effluents adsorption was strongest in the acidic and basic pH regions (3-5 and 10-11), which favored the highest proportion of undissociated molecules. Although pH adjustment of municipal effluents to aid activated carbon adsorption is not justified, it may have an application in industrial wastewater treatment. (Cassar-FRC)
W82-04568

EVALUATION OF INSTRUMENTS FOR CONTINUOUS ACTIVATED SLUDGE MONITORING,
Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, E. G. Luxon, B. A. Monaghan, and R. G. Gillespie.
Water Science and Technology, Vol 13, No 11/12, p 721-728, 1981. 10 Fig, 4 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Wastewater treatment, *Monitoring, Acidity, Dissolved oxygen, Suspended solids, Temperature, Flow rates, Organic carbon, *Activated sludge process.

The performance of selected commercial monitoring instruments including those for the measurement of dissolved oxygen, pH, suspended solids, temperature, flow and organic carbon has been evaluated. The pilot plant facilities used consist of two identical parallel activated sludge units with a common primary clarifier, and secondary clarifier surface areas. Degritted raw sewage is fed to the primary clarifier at a constant flow rate with uncontrolled variations in constituent concentrations. Primary effluent and return activated sludge are fed to each biological reactor with a maximum flow of 21.6 cubic meters/day. Diffused air is introduced through perforated PVC piping. Three identical dissolved oxygen instruments were monitored and compared to an air-calibrated reference YSI model 54 oxygen meter. Each instrument performed adequately for 141, 125, and 114 days before attention was needed. Two on-line mixed liquor suspended solids instruments and two RASS instruments were assessed by comparison to reference gravimetric analysis. One on-line self cleaning ISS analyzer and two flow-through ESS analyzers were evaluated by comparison to gravimetric results. The study concluded that suitable instruments exist for continuously monitoring the activated sludge process. The accuracies and instrument standard deviations measured indicate that instruments are sufficiently reliable for continuous monitoring and control functions associated with their use. Adequate maintenance and calibration are required if results are to be acceptable. (Baker-FRC)
W82-04594

DYNAMIC STEP FEED CONTROL FOR ORGANIC CARBON REMOVAL IN A SUSPENDED GROWTH SYSTEM,
Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
L. J. Yust, J. P. Stephenson, and K. L. Murphy.
Water Science and Technology, Vol 13, No 11/12, p 729-736, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Organic carbon, *Wastewater treatment, Wastewater facilities, Activated sludge process, Oxygen uptake, Process control, Effluent, Effluent variability reduction.

The objective of the present study was to reduce effluent variability from wastewater treatment operations. The study investigated the usefulness of SCOUR control (Specific Oxygen Utilization Rate), which is a dynamic indicator of sludge activity, the nature of pollutants, and the substrate reactor concentration. SCOUR is dependent on both the biological oxygen uptake rate and the concentration of activated sludge in the reactor. SCOUR control was achieved by using the step feed process when compared to a single tank completely-mixed process. Filterable organic carbon effluent data suggest that a reduced effluent variability can be obtained from a SCOUR control strategy during high loading periods. At low loading where SCOUR control was inadequate no improvement of SCOUR or effluent total organic

carbon variability was obtained in comparison with the system consisting of a single compartment completely mixed reactor with recycle. A further modification to the SCOUR controller constraints is required to obtain a unique optimal influent flow distribution if the SCOUR value of a three or more compartment system is to be controlled. The problem of increased effluent suspended solids concentrations must be addressed before SCOUR control can be fully evaluated. The maximum computing time for any one optimization did not exceed 10 minutes, making the iterative control presented acceptable for hydraulic time constants characteristic of the step feed activated sludge process. (Baker-FRC)
W82-04595

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,
G. Olsson.
Water Science and Technology, Vol 13, No 11/12, p 826-831, 1981. 15 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, Reviews, *Activated sludge process, Process control, *Costs, *Operating costs.

A workshop was conducted on improving operation and reducing operating costs at wastewater treatment plants through obtaining a better understanding of the dynamics of the plant and the application of instrumentation and control. The activated sludge process is used as a model for the study, as it forms the heart of most wastewater treatment plants and usually reguires the highest expenditure of energy. A common objective for plant operation is to minimize the variability of the effluent quality. Effluent quality measurements are often crude. More study is also needed in the area of the linkage between sludge retention time and energy demand, settleability, clarifying properties and activity. The sludge blanket level is cricial for the settler and clarifier operation, but varies widely in practice. Many plants are operated so as to keep the mixed liquor suspended solids concentration constant, but there is seldom any apparent reason for doing so. Dissolved oxygen control has been recognized as a rewarding and meaningful control means, from both an economical and biological viewpoint. The availability of good sensors for wastewater treatment is not satisfactory, sometimes due to a lack of knowledge or proper attitude on the part of the user rather than the manufacturer. Extensive research has been performed during the last decade to develop dynamic models for wastewater treatment systems. (Baker-FRC)
W82-04597

AUTOMATIC OPERATION OF A FREEZE-THAWING AND DEWATERING PLANT FOR SEWAGE SLUDGES,
Mitsubishi Electric Corp., Hyogo (Japan).
T. Honda, S. Hiro, and K. Yamanishi.
Water Science and Technology, Vol 13, No 11/12, p 599-604, 1981. 5 Fig, 3 Ref.

Descriptors: *Automation, *Sludge drying, *Sludge thickening, *Freeze drying, Control systems, Process control, Sludge conditioning, Sludge solids, *Wastewater treatment, Hydrogen ion concentration, Pilot plants, Cost savings.

An automatic control system for a freeze-thawing method of sludge dewatering is described. In the freeze-thawing method, agglomeration of solid sludge occurs during freezing, and the specific filtration resistance is decreased from 10,000 m/kg to 10 to the 12th power m/kg. This allows reductions in sludge moisture content of up to 65 wt% with simple dehydrators, resulting in great decreases in the amount of sludge. Since no coagulant is required during the process, additional water pollution problems are avoided. A density sensor is installed in the thickener to signal when the slurry should be drawn out by a pump to a storage tank. pH monitors are used during pH conditioning, and freez-thawing is controlled by brine temperature and a timer. A pilot plant has used the process with little trouble for over two years. The method is economically competitive with other dewatering techniques and reduces the mass of the dewatered cake to 1/2.5 of that of conventional methods. (Geiger-FRC)
W82-04599

APPLICATION EXAMPLES OF AND OPERATING EXPERIENCES WITH THE USE OF PROCESS COMPUTERS IN SEWAGE TREATMENT PLANTS,
Siemens A.G., Karlsruhe (Germany, F.R.).
E. F. Michel.
Water Science and Technology, Vol 13, No 10, p 483-488, 1981. 4 Fig, 5 Ref.

Descriptors: *Process control, *Computers, *Wastewater treatment, *Automation, Monitoring, Data processing, Wastewater facilities, Control systems, Operating costs, Electronic equipment, Maintenance costs, Netherlands, Sweden, Germany, Comparison studies.

The operating expeeriences of three sewage treatment plants, the Deventer facility (The Netherlands), the Malmo-Sjolunda plant (Sweden), and the Regenburg plant (Germany) are reviewed. The Deventer plant, which serves a population of roughly 120,000, is equipped with a SAMSY automated process control system. This system has been operating favorably since 1967 and has saved on energy costs, material, and personnel. The Swedish plant serves approximately 530,000 and features two central control stations. The entire process at the Malmo-Sjolunda plant is controlled and monitored by the SIMAT C/SAMSY automation system with the SIMATIC electronic control system as a backup for manual and remote controls. The Regensberg facility was designed to handle a population of 300,000 but plans to handle 400,000. This plant also uses the SIMAT C/SAMSY system along with free programmable electronic controls. These automated systems have improved process control, decreased power costs and reduced maintenance in the aforementioned plants. A new automation system concentrating on decentralized intelligence, the TELEPERM M, is also described. (Geiger-FRC)
W82-04600

EXPERIENCE WITH COMPUTER CONTROL OF WASTEWATER TREATMENT PROCESSES AT LOS ANGELES AND OTHER COMMUNITIES,
Los Angeles Bureau of Sanitation, CA.
W. F. Garber, and J. J. Anderson.
Water Science and Technology, Vol 13, No 11/12, p 759-770, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Computers, *Automation, Design criteria, Reviews, *Los Angeles, California, Municipal wastewater, Process control, Case studies.

Case study reviews were made of computer controlled wastewater treatment centers at the Hyperion treatment plant at Los Angeles, the Terminal Island treatment plant in Los Angeles, and the Glendale Water Reclamation Plant in Los Angeles, as well as treatment plants in Cleveland, Ohio; Bridgeport, Connecticut; Philadelphia, Pennsylvania; and Moorhead, Minnesota. The studies suggest that it is very difficult to provide isolated environmentally controlled spaces for computers in a wastewater treatment plant. Voltage or current variations lasting for microseconds could drastically affect the computer control systems when such systems were not isolated electrically from the power system supply lines. An analog control loop or other means of control should be provided for selected critical steps or processes, and these should be interfaced with the central processing computer. Computer control systems should not be designed as hybrid systems to handle process control and data processing. Conditions other than maximum should be considered during the design stage. The complexity of the computer control system and the frequency of measurement needs to be carefully studied prior to design. A prime manufacturer/installer should be selected who has the ability and desire to make an installed system work as designed. Cities and operating authorities must provide in advance the necessary trained and dedicated personnel. A number of large central process control computers are not meeting the reliability requirements needed for their acceptance as a useful tool for wastewater control. (Baker-FRC)
W82-04609

AUTOMATIC CONTROL OF SOLIDS RETENTION TIME AND DISSOLVED OXYGEN IN THE ACTIVATED SLUDGE PROCESS,
Environmental Protection Services, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, B. A. Monaghan, and P. J. Laughton.
Water Science and Technology, Vol 13, No 11/12, p 751-758, 1981. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, *Activated sludge process, *Dissolved oxygen, Monitoring, Solids, retention time.

This paper summarizes the dissolved oxygen (DO), solids retention time (SRT), and oxygen uptake rate (OUR) control approaches investigated at pilot scale. The pilot plant consisted of two identical parallel activated sludge units. The results indicate that a computer controlled facility can provide control of the instantaneous SRT equivalent to a well operated manually controlled plant. Energy savings and improved process operating conditions are achieveable through automatic dissolved oxygen control in activated sludge systems. The use of on-line process analyzers for flow and suspended solids, interfaced to a process computer, can provide effective solids inventory control in activated sludge systems. Automatic SRT control can provide solids inventory control equivalent to that achieved in a well controlled manually operated plant. No significant difference can be expected in the effluent quality based on effluent suspended solids. The use of OUR for control of plant solids inventory can be automated readily and merits further development and evaluation. (Baker-FRC)
W82-04610

WASTE WATER TREATMENT PLANT RELIABILITY - ENGINEERING DESIGN FOR FAILURE AND ECONOMIC GAIN,
UKAEA Systems Reliability Service, Warrington (England).
K. C. Hignett, and B. Sayers.
Water Science and Technology, Vol 13, No 11/12, p 743-750, 1981. 5 Fig.

Descriptors: *Mathematical models, *Wastewater treatment, Water treatment facilities, *Wastewater facilities, *Design criteria, Economic aspects, Engineering, Systems engineering, Case studies.

Quantified assessments of systems' availability may be derived on the basis of fault tree logic and mathematical modelling. The techniques described require a knowledge of representative failure data and downtimes. A data collection and availability modeling procedure were developed. A case study on sixteen wastewater plants was performed over a three year period, beginning in mid 1978. The study related to primary sedimentation systems, but the techniques are applicable to any system where basic failure data can be obtained. The analyses enabled weak areas in the systems to be identified and recommendations made for improving reliability. The results often confirmed the intuitive feelings of plant managers and made it possible to quantify the effects of different proposed improvements. The increased application of reliability technology can provide an important contribution to the realization of more efficient and lower cost waste water processing systems. (Baker-FRC)
W82-04611

ESTIMATION AND CONTROL PROBLEMS IN ACTIVATED SLUDGE PROCESSES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. Cook, and S. Marsili-Libelli.
Water Science and Technology, Vol 13, No 11/12, p 737-742, 1981. 2 Fig, 7 Ref.

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Descriptors: *Activated sludge process, *Control systems, *Model studies, Mathematical studies, Wastewater treatment, Water quality, Monitoring.

This paper assesses the feasibility of some estimation and control schemes applied to the time varying operation of the Activated Sludge Treatment Process (ASTP). Real-time control of ASTP is becoming a significant issue in the context of water quality management. Preliminary results concerning the estimation of process variables are presented, and some new control concepts which imply the notions of optimality and energy conservation are introduced. Estimation and control algorithms developed are based on a reduced order model, thus making them easily implementable on microprocessors. Numerical simulation results are presented and discussed to assess the relative merits of the various algorithms. While far from exhaustive, this partitioned approach as demonstrated has shown the viability of Extended Kalman Filtering (EKF) state/parameter estimation and of optimal feedback control. Simulations have shown that improved performance and energy conservation can be achieved by using biochemical oxygen demand as a direct control variable. A foreseeable extension of the EKF properties concerns the inclusion in the performance index of some measure of upstream quality. In this way, the treatment cost can be made dependent of the present condition of the receiving water body. This, in addition to providing very sensible set points for diurnal operation, may help reduce treatment costs in many cases of medium or high flow conditions. (Baker-FRC)
W82-04612

PULSED-BED TECHNIQUE CAN CUT TREATMENT STAGES,
J. Irwin.
World Water, Vol 4, No 12, p 42-43, December, 1981. 1 Fig, 5 Tab.

Descriptors: *Percolating filters, *Backwash, Effluent, *Wastewater treatment, *Filtration, Sand filters, Filters, Separation techniques, Costs, Filter media, Clarification, Sludge treatment.

Pulsed-bed filtration is being used increasingly for primary effluent filtration (PEF) to reduce secondary treatment costs in municipal sewage plants as part of plant upgradings or expansions. Pulsed-bed units have a much shallower filter cell than conventional filters and can operate at heads of 0.6-1.5 m. They can accommodate high loading rates and cost less to backwash due to a special air diffuser device over the media surface. A pulse mix system helps fold the majority of particles into the media, while a screen media-retaining system permits filter media to be placed directly on top of the underdrain system for improved backwashing. A chemical detergent is used during backwashing, and a backwash control system recycles backwash water to a separate clarifier. The Hydro Clear Corporation has experimented with placing a pulsed-bed filter after the primary clarifier at several pilot plants. These efforts showed that primary clarification, PEF, and trickling filtered produced secondary quality effluent without final clarifiers at great cost reductions. Sludge treatment was also easier with PEF. Hydro Clear is developing a fine-sand pulsed-bed filtration technique for algae removal which may also be useful in potable water development and wastewater reuse. (Geiger-FRC)
W82-04613

DETOXIFICATION OF WASTE WATER CONTAINING CYANIDES FROM THE WET-SCRUBBING SYSTEMS OF STEEL MILLS (ENTGIFTUNG CYANIDHALTIGEN GICHTGASWASCHWASSER VON HOCHOFEN),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Fischer, H. Ruffer, W. Duppers, G. Nagels, and H. Knorre.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 210-217, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Cyanide, *Steel industry, Effluents, Wastewater oxidation, Hydrogen peroxide, Formaldehyde, Catalysts, Weser River, Standards, *Germany.

Blast-furnace stack gas in steel mills is wet-scrubbed prior to utilization of its heat content. At the Bremen plant of the Klockner-Werke AG, process water is withdrawn from the Weser River; prior to return it must be treated to meet effluent standards, including a cyanide ceiling of 0.1 mg/liter. Various treatments for oxidative cyanide detoxification in scrubber water were considered: hypochlorite, ozone, catalytic oxidation with active carbon, peroxydisulfates, potassium permanganate, hydrogen peroxide, hydrogen peroxide/formaldehyde, and peroxymonosulfuric acid. Following laboratory trials, pilot tests were set up using the last four methods. The hydrogen peroxide-formaldehyde process was selected for full-scale trails. The initial settling basin was selected as the site for chemical introduction, since the turbulence of the inflowing stack gases provided adequate mixing. Sodium hydroxide was added to raise the pH of this water to 9-10. Chemical addition was metered via a sample stream. The goal of purifying the average flow of 1400 cu m per hour of wastewater at a maximum cyanide ion content of 50 mg/liter to register less than 0.1 mg/liter was attained during 93.5% of the measurement intervals in 6 months of operation. The standard for effluent from the settling basin, 1 mg/liter, was exceeded in 2.5% of the intervals, mostly for brief periods, due to operational problems. Chemical costs were about 2700 German Marks per day; the relatively high labor costs were primarily attributable to analytical requirements. The plant operated reliably even under the intensified demands caused by blast furnace shutdown. (Carroll-FRC)
W82-04616

DEMONSTRATION OF ZINC CYANIDE RECOVERY USING REVERSE OSMOSIS AND EVAPORATION,
Abcor, Inc., Wilmington, MA.
K. J. McNulty, and J. W. Kubarewicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-231243, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-132, September, 1981. 6 p, 3 Fig, 6 Ref. R805300.

Descriptors: *Metal-finishing wastes, *Reverse osmosis, *Evaporation, *Wastewater treatment, *Water reuse, Industrial wastewater, Zinc, Cyanide, Cost analysis, *Zinc cyanide recovery.

A field test was conducted to demonstrate closed-loop recovery of zinc cyanide rinse-water at a job shop plating facility. Since the zinc cyanide bath operates at room temperature with very little evaporation from the bath, reverse osmosis (RO) treatment of the rinsewater must be supplemented by evaporation in order to achieve the volume reduction necessary for return of a concentrate to the plating bath. The permeate from the RO unit was recycled to the first rinse after plating, while the distillate from the evaporator was recycled to the second rinse after plating. Spiral-wound PA-300 membrane modules were used in the RO unit. A gradual loss in membrane performance is attributable to fouling of the membrane by particulates in the rinsewater. Such fouling can be reduced by better prefiltration and reversed by periodic cleaning. The economics of the combined RO evaporation system were assessed for a system designed to provide rinsing equivalent to the present two-stage counter-current rinse at the demonstration site. The total operating cost was somewhat less for the combined RO evaporation system than for evaporation alone. However, credits for rinsewater recovery were insufficient to completely off-set the total operating cost of the recovery system. (Moore-SRC)
W82-04622

EVALUATION OF A TREATMENT LAGOON FOR COMBINED SEWER OVERFLOW,
Environmental Design and Planning, Inc., Boston, MA.
D. J. Connick, W. C. Pisano, and GL. Aronson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105214, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-196, December, 1981. 7 p, 6 Tab, 1 Ref. 11023FAV.

Descriptors: *Wastewater lagoons, *Combined sewer overflows, Disinfection, Stabilization lagoons, *Wastewater treatment, Industrial wastewater, Chlorination, Chlorine dioxide, Aerators, Oxygenation, *East Chicago, *Indiana.

The East Chicago Sanitary District operates a wastewater treatment plant that handles about 19 mgd of dry weather municipal wastewater from the city of East Chicago, Indiana. The sewerage system has combined sewers with overflows containing direct industrial discharges and runoff from industrial areas. The world's largest facultative lagoon was constructed tere to polish the secondary effluent from the wastewater treatment plant and to provide preliminary treatment with disinfection to the combined sewer overflows. Volume of the lagoon is estimated to be 142.2 million gal. Results of a two-year evaluation of the East Chicago lagoon indicate that relatively good treatment can be provided by a deep stabilization pond. During dry weather flow periods, the lagoon provided removal capabilities of 30 to 70% for the secondary effluent, depending on the parameter. The reoxygenation function of the aerators was found to be necessary. Under most circumstances, four aerators were adequate, but at times of high organic loading, the use of all eight appeared to be more advantageous. Disinfection results indicated that chlorination should be used until more reliable chlorine dioxide equipment is provided. The chlorine dioxide system should be reconstructed to provide extensive mixing upon initial disinfection, and it should provide a 15 to 30 second delay time between doses. (Moore-SRC)
W82-04623

PARALLEL EVALUATION OF AIR- AND OXYGEN-ACTIVATED SLUDGE,
Los Angeles County Sanitation Districts, Whittier, CA.
S. Austin, and D. Wuerdeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246712, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-155, September, 1981. 6 p, 5 Tab. 14-12-150.

Descriptors: *Activated sludge, *Wastewater treatment, *Secondary wastewater treatment, *Pilot plants, Aeration, Nitrification, Denitrification, Clarification, Trace metals, Organic compounds, Solids, Comparison studies, Carson, California.

To provide data on the relative merits of air and of oxygen in the activated sludge process, two 1,900 cu m/day activated sludge pilot plants were operated side-by-side at the Joint Water Pollution Control Plant, Carson, California. One incorporated the UNOX high-purity oxygen process, and one used an air-sparged mechanical aerator. Although both pilot plants met the applicable discharge limitations for everything but three trace metals, the oxygen system provided a more stable operation. The two systems obtained good removals of soluble organics, and factors affecting solids separation in the final clarifier are most significant in terms of their effects on effluent quality. The most notable detrimental factors encountered in the study were excessive input of aerator power, which sheared the flocs in both systems and nitrification-denitrification, which caused the settled sludge from the air system to resuspend. The oxygen system did not nitrify. Claims have been made that oxygen-activated sludge processes produce less sludge than air-activated sludge processes. In this study, the total plant solids were compared and the difference was found to be insignificant at the 90% confidence level. The results of power consumption estimates indicate that the oxygen systems use substantially less energy. (Moore-SRC)
W82-04624

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,

Rockwell International, Newbury Park, CA.
I. Lysyj.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-101361, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-192, October, 1981. 6 p, 3 Fig, 2 Tab. 68-03-2648.

Descriptors: *Ballast, *Oily water, *Oil tankers, *Wastewater treatment, Fjords, Trap zone, Stratification, Alaska, Hydrocarbons, Effluent, Organic compounds, Organic loading, Water pollution sources, Valdez, Alaska.

The large, modern ballast water treatment plant at the Valdez, Alaska, marine terminal was studied using specially developed chemical analytical methods to determine the effectiveness of each unit process and to characterize compositional changes in the process stream. The studies disclosed that the state-of-the-art processes are generally effective in reducing the free oil content of the oily wastewater discharged from arriving tankers. A reduction of more than 99.8% in the organic load of the process stream is realized with ballast water treatment by gravity separation, dissolved air flotation, and retention in polishing ponds. Less effectively removed, however, are the water soluble fractions of the oily wastewater, which often include five priority pollutants: benzene, toluene, ethylbenzene, phenol, and naphthalene. Such priority pollutants make up more than 50% of the total organic load in the effluent from the ballast treatment plant, and they are discharged in significant quantities into the receiving waters of Port Valdez. The plant discharges approximately half a metric ton of organic carbon each day. Included in this daily dischargew are 102 L of benzene, 91 L of toluene, 45 L of ethylbenzene/xylenes, 27 kg of phenol, and 2.8 kg of naphthalene. Because benzene, toluene, and ethylbenzene/xylenes constitute a significant fraction of the total organic discharge, their distribution in the receiving waters was studied. During the summer months, when the waters of the fjord are stratified, the effluent does not mix uniformly with the receiving waters, but forms a submerged field of diluted effluent. The aromatic hydrocarbons are contained at a depth of 50 to 70 m in a thin trap zone that spreads horizontally as far as 2 to 3 km from the plant outfall. The top of the trap zone moves progressively farther below the surface as the summer heating season progresses, from 50 m in June to 65 m in September. No aromatic hydrocarbons were found in the fjord outside the confines of the trap zone.
W82-04625

THE DEVELOPMENT OF DESIGN EQUATIONS FOR FACULTATIVE WASTE STABILIZATION PONDS IN SEMIARID AREAS,
J. P. Arthur.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 197-213, March, 1981. 13 Fig, 10 Tab, 14 Ref.

Descriptors: *Waste treatment, *Stabilization ponds, *Wastewater treatment, Temperature, Organic loading, Detention time, Bacteria, Sewage bacteria, Biological oxygen demand, *Nigeria, Semiarid lands, Ponds, Performance evaluation, Design criteria.

A comprehensive pilot scale study of waste stabilization ponds was conducted in semiarid northern Nigeria for a year. Two small ponds and 44-gal oil drums were arranged in various parallel and series combinations to investigate the effects of climatic factors and changes in organic loadings and detention times. The experimental systems provided excellent BOD and fecal bacteria removal. Anaerobic conditions occasionally developed as a result of overloading, but facultative operation became reestablished when favorable conditions returned. Temperature had a more significant effect on BOD and fecal bacteria removal than solar insolation. Equations were developed to aid in design of waste stabilization pond systems. Series ponds were more effective than single units. Other factors which promoted treatment efficiency were complete mixing, increased detention time, and optimum organic loading. (Cassar-FRC)
W82-04641

PILOT STUDIES OF THE NITRIFICATION PROCESS IN FIXED FILM REACTORS (PILOTVERSUCHE ZUR NITRIFIKATION IN FESTBETTREAKTOREN),
Hamburg Univ. (Germany, F.R.).
I. Sekoulov, and D. Heinrich.
Wasserwirtschaft, Vol 71, No 11, p 331-333, 1981. 4 Fig, 2 Tab, 3 Ref. English summary.

Descriptors: *Aerobic digestion, *Wastewater treatment, *Nitrification, Pilot plants, Fixed film reactors, *Germany.

The ability of nitrifying bacteria to grow attached to solid surfaces can be optimally utilized in fixed film reactors in order to concentrate them in a system. After the growth phase of the nitrifiers is complete, the hydraulic loading (residence time) is of practical importance for the nitrification behavior of the fixed bed reactor. Nitrifiers show ability to adapt to low oxygen concentrations and pH values, especially when they have been grown under these conditions. The nitrifiers produce very thin biological films which in themselves do not cause clogging of the reactors. However, when used in wastewater treatment the fixed bed reactors encounter suspended solids. In such cases it is necessary to provide the possibility for back-washing. The filler materials must permit uniform circulation. Expanded clay beads have proven to be acceptable filler materials. The proper size of a fixed-bed reactor can be selected with the aid of the Michaelis-Menten equation. Pilot-scale studies were conducted with two conventional fixed bed reactors, connected in parallel, and a completely immersed, rotating fixed bed reactor. In the case of non-limiting ammonium concentrations and short residence times, e.g., 0.5 hr, a maximal nitrification speed relative to the surface area of the filler material of 58.7 mg ammonium nitrogen per sq m per hr was achieved. If the nitrification rate is calculated relative to the reactor volume, the result is about 10 times higher than previously available values for activated sludge plants. (Carroll-FRC)
W82-04652

COMPARATIVE DISINFECTION OF POLIOVIRUS BY BROMINE CHLORIDE AND CHLORINE IN A MODEL CONTACT CHAMBER,
Hawaii Univ., Honolulu. Dept. of Tropical Medicine.
B. H. Keswick, R. S. Fujioka, N. C. Burbank, and P. C. Loh.
Water Research, Vol 16, No 1, p 89-94, January, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Disinfection, *Viruses, *Halogens, *Wastewater treatment, *Bromine chloride, *Chlorine, Chlorination, Poliovirus, Ammonium.

Bromine chloride proved superior to chlorine in inactivating poliovirus in 0.00009 M ammonium chloride solution and water containing 10% sewage effluent. In clear tap water both BrCl and Cl at doses of 0.5 and 2.0 mg per liter were effective disinfectants for poliovirus. The apparatus used for the studies was a 4 gal per min model contact chamber built to simulate conditions in a wastewater treatment plant. Concentrations of poliovirus in the initial mixture were 100,000 PFU per ml. The 2.0 mg per liter dose of BrCl was effective under all conditions. The 2.0 mg per liter dose of Cl failed to inactivate sufficient poliovirus when sewage effluent was present. (Cassar-FRC)
W82-04661

TEMPERATURE DEPENDENCY OF BIOLOGICAL DENITRIFICATION WITH ORGANIC MATERIALS ADDITION,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research, Vol 16, No 1, p 19-22, January, 1982. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Temperature, *Kinetics, *Denitrification, *Organic compounds, Biological treatment, *Wastewater treatment, Activated sludge process, Nitrogen removal, Methanol, Acetone, Acetic acid.

The rate of denitrification in a wastewater treatment process depends on temperature and on the compound used as the electron donor. Fresh activated sludge was incubated in laboratory plastic containers at eight temperatures from 2.5 to 35 C. Nitrate was added, followed by the organic compound, methanol, acetone, or acetic acid. Kinetic constants for the reactions are presented. Acetic acid was most effective in increasing the denitrification rate, acetone showed no improvement, and methanol was intermediate. The Arrhenius activation energy was similar in all cases, 10.9-12.3 kcal per mol. (Cassar-FRC)
W82-04662

TREATMENT OF NONCYANIDE ELECTROPLATING CADMIUM WASTEWATER BY REVERSE OSMOSIS,
Shanghai Inst. of Mechanical and Electrical Engineering (China).
F. Menwei, B. Tingyong, L. You, and Z. Aili.
Water Science and Technology, Vol 13, No 11-12, p 517-522, 1981. 3 Fig, 1 Tab.

Descriptors: *Cadmium, *Separation techniques, *Reverse osmosis, *Electroplating, *Wastewater treatment, Industrial wastes, Heavy metals, Membrane processes, Osmosis, Water pollution prevention, Chelating agents, Industrial wastewater.

Since cadmium (Cd) is hazardous to the environment and human health, the removal of Cd from the wastewaters of industries using Cd electroplating is an area of constant consideration. Reverse osmosis, a membrane separation technology, has been applied to noncyanide electroplating Cd rinse water. Closed-loop rinse systems using cellulose acetate membranes were tried in laboratory and pilot plant tests. The reverse osmosis units were of an out-press tubular structure and gave an average flux of 17 liters/sq m-h. At an operating pressure of 30 kilograms/sq cm Cd rejections of 95-98% were obtained. The reverse osmosis installation and its attachments require only 10 sq m of space and can restore 99% of the amount of Cd previously discharged. The present system when aided by some simple controllers was found to be suited for small-scale wastewater treatment operations. (Geiger-FRC)
W82-04664

ON LINE CONTROL OF PHARMACEUTICAL INFLUENT LOADS TO A BIOLOGICAL WASTEWATER TREATMENT PLANT,
OTV, Coubevoie (France).
A. Minier, H. Moreaud, G. Castelnau, and M. Mevolhon.
Water Science and Technology, Vol 13, No 11-12, p 523-529, 1981. 5 Fig.

Descriptors: *Biological wastewater treatment, *Flow regulators, *Activated sludge, *Respiration, *Wastewater treatment, Process control, Biodegradability, Fluctuations, Industrial wastes, Biological treatment, Pollution load, Control systems, *Pharmaceutical wastes.

A special pollution flux-regulator for the biological treatment of effluents in cases where the composition and flow rate are subject to considerable variation is described. The system is an industrial application of the metabolization technique in which wastewater is batch injected into a reactor containing activated sludge. A rapid respirometric test shows the affinity between the influent and the sludge bacteria and from this the biological reaction parameters are deduced. These parameters are then used to calculate the maximum load and hydraulic properties of the facility. This system has been successfully operated since July of 1980 for the treatment of wastes from the SAPCHIM pharmaceutical factory at Sisteron, France. An on-line biodegradability analyzer helps to regulate the flow between the storage tank and the contact tank of a biological treatment line by a contact-stabilization process. (Geiger-FRC)
W82-04665

OPTIMIZATION OF AREAWIDE WASTEWATER MANAGEMENT,

LIBRARY U. OF I., URBANA-CHAMPAIGN

Landfills, Slope stability, Soil properties, Soil mechanics, *Minnesota, Water pollution control, *Solid waste disposal, Dikes, *Clay Boswell Generating Station.

The planning, construction, and operation of a solid waste disposal pond for the Clay Boswell Generating Station, Minnesota, are described. This fossil fuel-burning plant is expected to produce 12.3 million cu m of solid waste (fly ash, bottom ash, and SO2 scrubber sludge) over its 35-year life. Wet ponding was chosen over two alternatives, chemical stabilization for landfill disposal and disposal in open pit iron mines. Boring tests located a suitable pond site with a continuous subsurface clay layer. The soils were further studied in the laboratory. The final design for the pond was an embankment built of random soil with a clay lining constructed on the upstream embankment slope. The entire pond was clay lined and soil-bentonite slurry cut-off trenches were installed down to the natural clay layer. Seepage calculations predicted a total long-term steady state seepage rate of 450 gal per acre per day. The pond, constructed during 1978 and 1979, consists of three compartments divided by earth dikes. Ash is kept covered with 2 ft of water. Piezometers, settlement mounments, and visual inspections are used for monitoring pond performance, which had met design expectations. A seepage problem in one compartment was the result of a frozen dividing dike. A reverse filter drainage system was constructed in the problem area to relieve the excessive piezometric head. (Cassar-FRC)
W82-04385

DENSITY LEVELS OF PATHOGENIC ORGANISMS IN MUNICIPAL WASTEWATER SLUDGE - A LITERATURE REVIEW,
Camp, Dresser, and McKee, Inc., Boston, MA.
D. C. Pederson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102286, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-170, October, 1981. 5 p, 2 Tab. 68-03-2803.

Descriptors: *Sludge drying, *Pathogens, *Disinfection, Parasites, *Viruses, *Bacteria, *Wastewater treatment, Literature review, Public health, Indicators, Lime, Anaerobic digestion, Composting, Aerobic digestion, Pathogenic fungi, Eggs, Sludge disposal.

Sludges originating from municipal wastewater treatment plants harbor a multitude of microorganisms, many of which present a potential health hazard. A literature review of available domestic and foreign data from 1940 to 1980 was undertaken concerning bacteria, viruses and parasites densities in raw municipal wastewater sludges, on the effectiveness of the 'Processes to Significantly Reduce Pathogens' (40 CFR Part 257), and on conventional sludge dewatering techniques to reduce levels of these organisms. Anaerobic digestion and lime stabilization consistently produce reductions of about 1 to 2 logs in densities of indicator and pathogenic bacteria, and in the case of anaerobic digestion, in densities of viruses as well. Conditions of mesophilic composting may inactivate common indicator and pathogenic bacteria and viruses, provided that specified temperatures are attained uniformly throughout the compost mass. The pathogenic fungus Aspergillus fumigatus thrives under conditions of mesophilic composting. Density reductions of bacteria by aerobic digestion are variable and of relatively small magnitudes. Sludge lagoons can achieve 1-log reductions in densities of bacteria and viable parasite ova, but storage of one month to more than three years may be required. Mechanical dewatering of sludge, with or without the use of chemical conditioners, has little reliable effect on densities of pathogens. (Moore-SRC)
W82-04400

DEEP WELL DISPOSAL OF SECONDARY EFFLUENT IN DADE COUNTY FLORIDA,
CH2M/Hill Inc., Gainesville, FL.
U. P. Singh, J. I. Garcia-Bengochea, and C. R. Sproul.
Water Resources Bulletin, Vol 16, No 6, p 812-817, October, 1980. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater disposal, *Deep wells, *Transmissivity, Groundwater movement, *Injection wells, Underground waste disposal, Environmental effects, Groundwater management, Geophysics, Wastewater management, Subsurface drainage, Aquifer management, Aquifers, *Florida, Saline water intrusion, Dade County.

Drilling and testing were carried out on a test injection well site for deep underground injection of wastewater effluent from the proposed 50 mgd South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority. The total depth of the well is 3,200 ft. The Boulder Zone, a highly cavernous and transmissive aquifer with water much like seawater, begins at 2,790 ft in depth. This zone is separated from the Floridan aquifer above it by about 1,100 ft of confining limestone layers. Packer testing proved these limestone layers very effective in separating the Boulder Zone, the proposed injection area, from the aquifer above. The transmissivity of the Boulder Zone was estimated at 14 million gallons/day/ft from pump-out test data. An 8,000 gallon/minute injection test was performed to evaluate well performance under operating conditions. A detailed monitoring program consisting of subsurface wells in various strata will be provided to monitor injection rate, injection pressure and effluent quality. A possible remedial action for salt water migration into the Floridan aquifer would be the construction of relief wells in the lower part of the aquifer. It was concluded that underground injection of secondary wastes from the proposed treatment facility is a feasible and cost-effective plan, both hydraulically and environmentally. (Geiger-FRC)
W82-04442

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL--FISCAL YEAR 1979,
Geological Survey, Reston, VA. Water Resources Div.
R. Schneider, E. H. Roseboom, Jr., J. B. Robertson, and P. R. Stevens.
Available from Br. of Distr., USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 847, 1982. 74 p, 15 Fig, 79 Ref.

Descriptors: *Radioactive waste disposal, *Geological surveys, *Waste storage, *Water pollution sources, Environmental effects, Waste management, Geology, Hydrology, Geochemistry.

The report summarizes progress on geologic and hydrologic research related to the disposal of radioactive wastes. The research is described according to whether it is related most directly to: (1) high-level and transuranic wastes; (2) low-level wastes, or (3) uranium mill tailings. Included is research applicable to the identification and geohydrologic characterization of waste-disposal sites, investigations of specific sites where wastes have been stored, and studies of regions or environments where waste-disposal sites might be located. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and(or) retention of waste radionuclides. (USGS)
W82-04500

AUTOMATIC CONTROL OF THE SEWAGE SLUDGE PYROLYSIS PROCESS IN MULTIPLE HEARTH FURNACE,
NGK Insulators, Ltd, Nagoya (Japan).
T. Kasakura, T. Majima, and N. Izumi.
Water Science and Technology, Vol 13, No 11-12, p 605-610, 1981. 3 Fig, 1 Tab.

Descriptors: *Incineration, *Sludge disposal, *Cost analysis, *Solid waste disposal, Automation, Control systems, Waste disposal, Sludge, Monitoring, Process control, Solid wastes.

An automatic control system for a 60 T/day sewage sludge pyrolysis plant with multiple hearth furnace has been developed as an energy-saving alternative to conventional incineration. The new control system maintains the required furnace temperature through control of the partial combustion ratio of the furnace by adjusting the amount of air supplied to the furnace. It also features stable automatic gas analysis and monitoring under severe conditions. A feed forward method is used to control the furnace and combustion chamber pressure, and the steam line of the waste heat boiler is designed so that some steam may be recycled other uses. These features result in a fuel comsumption one third that of conventional incineration methods. (Geiger-FRC)
W82-04587

AUTOMATIC CONTROL OF SLUDGE CONDITIONING AND VACUUM FILTRATION,
EMA, Inc., St. Paul, MN.
D. I. Knudsen, and G. A. Mathes.
Water Science and Technology, Vol 13, No 11/12, p 611-617, 1981. 6 Fig, 1 Tab.

Descriptors: *Sludge conditioning, *Vacuum filtration, Costs, Automation, Computers, *Activated sludge process, Sludge, Filtration, *Sludge disposal, Incineration, Process control.

This paper reports progressive development of control strategies and the resultant benefits derived from the Seneca Treatment Plant in Eagen, Minnesota. The plant is a 24 mgd activated sludge plant with two paralles 12 mgd trains. Two identical sludge processing trains consist of flotation thickeners, sludge holding tanks, chemical conditioning with ferric chloride and calcium hydroxide, vacuum filters, multiple hearth incinerator, and ash disposal by one common pipeline to a remote ash pond. The developmental nature of the project required a flexible control system. A microcomputer-based remote terminal unit communicates with a minicomputer over a four-wire asynchronous 1200 baud link. The minicomputer with its operations console is located in a buliding remote from the sludge disposal building. Various types of sludge conditioning and vacuum filter automatic process control resulted in economic benefits. The highest savings are achieved with a multivariable model based control strategy. Instrumentation requirements are met with proven equipment that does no require excessive maintenance. Properly applied sludge conditioning control strategies reduced ferric and lime usage, stabilized performance, increased production capacity, improved incinerator performance and decreased fuel usage. Operator and laborer requirements can be reduced because the control system can maintain continuity of stable operation with various sludge and chemical qualities. (Baker-FRC)
W82-04589

DENSIFICATION OF PAPER MILL SLUDGE MATERIALS,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
O. B. Andersland, A. W. N. Al-Khafaji, and R. K. Loew.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 1-15, January, 1982. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Dewatering, *Pulp and paper industry, *Compressibility, Sludge thickening, *Sludge disposal, Organic matter, Decomposition, Landfills, Void ratio, Waste disposal.

Densification of model paper mill sludges made from kaolinite and pulp fibers was studied to predict settlement of decomposing sludges. Densification involves removal of additional water from dewatered sludge, usually by placing surcharge loads in a landfill. Ignition tests were used to determine the organic content, and compression tests to follow the course of decomposition. The relationship between void ratio and organic fraction for a constant stress level was shown to be linear for the model sludges. A method was developed to calculate the void ratios as a function of pressure and organic content. These values agreed well with field data. Predictions of settlement of

decomposing sludges were formulated from the initial and final void ratios and the degree of decomposition. (Cassar-FRC)
W82-04694

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,
Colorado E Agricultural Experiment Station, Fort Collins.
K. A. Barbarick, B. R. Sabey, and N. A. Evans.
Journal Water Pollution Control Federation, Vol 54, No 1, p 70-76, January, 1982. 7 Tab, 29 Ref.

Descriptors: *Land disposal, *Wastewater treatment, *Meadows, Effluents, Wastewater, Phosphorus, Sodium, Chlorides, Potassium, *Wastewater irrigation, Irrigation, Crop yield, Hay, Grasslands, *Impaired water use, Colorado, Hayden area.

Changes in the water, soil, and plant properties of a mountain meadow caused by sprinkler application of wastewater effluent or ditch water and the presence of subsurface drainage tiles or natural drainage were investigated. The study was conducted near Hayden, Colorado, at an elevation of 1977 meters, a latitude of about 41 degrees C, and a population of about 1,000. Ranching, farming and coal mining are the main industries of the area. A mountain meadow situated west of the Hayden wastewater treatment lagoons was used for the field study. The soil profile consists of layers ranging from a dark brown, silty clay loam to a mottled gray-brown clay. A gravel lens is encountered at depth of 1.5 to 2.0 meters. The meadow has been used for hay production for at least 10 years and has been flood irrigated continuously during this period. Application of effluent to the meadow produced only a few significant changes in area characteristics. Effluent caused significant increases in the chloride and sodium ion concentrations and uptake of sodium by plants in 1977. Hay yields, protein production and sodium and phosphorus uptake by plants were increased in 1978, and the concentrations of phosphate-phosphorus and exchangeable sodium and potassium in surface soil samples were also increased. Drainage tiles effectively lowered the water table for most of the 1977 irrigation season. The groundwater was below the drainage tiles in most of the 1978 season. Application of the effluent to the meadow for 2 years indicated that no environmental or health hazards resulted. (Baker-FRC)
W82-04705

5F. Water Treatment and Quality Alteration

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,
Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
H. Sontheimer, W. Kolle, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 73, No 11, p 572-579, November, 1981. 11 Fig, 1 Tab, 36 Ref.

Descriptors: Corrosion inhibition, *Scaling, *Iron, Water distribution, Water mains, *Corrosion control, Water quality, Siderite, Ferrous carbonate, Calcium carbonate, *Pipes, Water supply systems, Protection, Chemical precipitation.

The concept that siderite ($FeCO_3$) is important in the formation of a protective, corrosion-inhibiting layer in water distribution pipes has led to a siderite model. The model is based on the following reactions: primary--formation of ferrous ion and 2 electrons from elemental iron, formation of hydroxyl ions from water, and formation of carbonates from bicarbonate; secondary--formation of calcium carbonate, ferrous carbonate, and goethite (FeOOH); tertiary--fromation of goethite pseudomorph and magnetite (Fe_3O_4) from ferrous carbonate. Laboratory studies were performed by measuring corrosion rates in steel pipe and by analyzing the chemical composition of the scale. Water from the Karlsruhe, Federal Republic of Germany, distribution system was used. Scales formed from highly buffered water contained 85-90% ferrous iron and 10-15% ferric iron. In slightly buffered water the ferrous portion was 40%. The more ferrous iron in the scale, the better the corrosion protection. The presence of humic acids, calcium ion, and lower oxygen concentrations all increased corrosion protection. although this simplified model cannot explain all observations, it may predict general trends. (Cassar-FRC)
W82-04270

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,
Water Purification Associates, Cambridge, MA.
C. Calmon.
Journal of the American Water Works Association, Vol 73, No 12, p 652-656, December, 1981. 2 Fig, 7 Tab, 42 Ref.

Descriptors: *Ion exchange, *Chelation, *Metals, *Water treatment, *Wastewater treatment, *Polymers, Resins, Heavy metals, Anion exchange, Cation exchange, Bactericides.

The 1935 discovery of ion exchange resins has led to development of selective and specific ion exchange materials for water and wastewater treatments. This review presents the characteristics of 21 of these resins. The standard ion exchangers using sulfonic, carboxylic, or amine groups are not selective. All ions are packed up rather than the ones of concern, such as toxic metals. Regenerant costs are high, and selective recovery of ions from effluents is very difficult. Recently developed resins can remove specific metals, such as Hg or Cu, or groups of metals, such as the rare earths. A chelate resin, an insoluble polymer to which is attached a complexing group, involves both ion exchange and chemical reactions. Chelate resins have some limitations. Reaction rates are slower, special operating conditions during elution are required, and high concentrations of elutants may be needed. Recently bactericidal resins have been developed. These rely on (1) the affinity of amino and carboxylic groups in the organisms' tissues for the ion exchange resins, or (2) the presence of a bactericidal agent in the resin. (Cassar-FRC)
W82-04275

THE SEARCH FOR A CORROSION INDEX,
Environmental Science and Engineering, Inc., Gainesville, FL.
J. E. Singley.
Journal of the American Water Works Association, Vol 73, No 11, p 579-582, November, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Corrosion index, *Calcium carbonate, *Water quality, Alkalinity, Water distribution, Solubility, *Water mains, Hydrogen ion concentration, *Water supply systems.

A review of corrosion indexes revealed that no general corrosion index is available. It is not likely that a single index can apply to all metals. Some indexes have been applied in inappropriate circumstances. Use of any corrosion index should first be correlated with field test results to determine if it is applicable to a given water. Among the corrosion indexes described are: Langelier (1936), based on the effect of pH on the solubility of calcium carbonate, and a modification by Larson and Buswell (1942); Ryznar's (1944) stability index, with higher numbers indicating a more saturated water; Dye's (1958) momentary excess concept, the casil index, and the aggressive index which accounts for alkalinity. All these methods based on carbonate solubility equations are a measure of solubility of calcium carbonate, not corrosivity. Other methods are based on the ability of water to attack metal pipes and include additional factors. Parameters that must be considered in developing a corrosion index are hardness, alkalinity, carbonate, carbon dioxide, pH, chloride, sulfate, ionic strength, conductivity, total dissolved solids, color, hydrogen sulfide, buffer capacity, phosphate, silica, dissolved oxygen, chlorine, and temperature. (Cassar-FRC)
W82-04279

THE SCIENTIFIC BASIS FOR CONTROL OF LEAD IN DRINKING WATER BY WATER TREATMENT,
Wiggins Teape Research and Development, Ltd. (England).
I. Sheiham, and P. J. Jackson.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 491-515, December, 1981. 8 Fig, 8 Tab, 10 Ref.

Descriptors: *Drinking water, *Lead, Potable water, Heavy metals, *Water treatment, Alkalinity, Acidity, Carbonates, Water supply systems, Water quality.

Work is described which was carried out to identify the factors of water quality which determine lead concentration, to provide the ability to predict the types of water which give rise to excessive lead concentrations, and to define the methods and quality targets for water treatment to minimize lead levels in water. To achieve these objectives, the composition of deposits on the interior walls of lead pipes has been examined, the solubility of lead in water in equilibirum with these deposits has been calculated, and experimental tests have demonstrated the effects of a range of possible methods of water treatment to reduce lead concentrations. The study concludes that lead concentrations in water from lead pipes are limited to a high degree by the solubility of lead in water, and that water treatment can reduce lead levels effectively by ensuring that this solubility is as low as possible. In low alkalinity water, low pH is the predominant cause of high lead concentrations, and pH elevation to about pH 8.5 is required but not generally necessary to increase alkalinity. Addition of orthophosphate is a secondary approach to the treatment of this type of water. For water of high alkalinity addition of orthophosphate is the favored method of treatment, as simple pH adjustment is unlikely to produce a significant decrease in lead concentration. The large increase in pH required to produce substantial reductions in lead levels would have to be preceded by softening or removal of alkalinity, which are subjected to considerable disadvantages. (Baker-FRC)
W82-04301

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,
For primary bibliographic entry see Field 3C.
W82-04317

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,
Department of the Air Force, Washington, DC.
For primary bibliographic entry see Field 8A.
W82-04319

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,
Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
For primary bibliographic entry see Field 5D.
W82-04320

REGULATING CORROSIVE WATER,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6B.
W82-04335

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-04348

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,
Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
F. O. Sargent, J. H. Mann, and T. N. Neiman.
Water Resources Bulletin, Vol 17, No 6, p 1008-1011, December, 1981. 1 Tab, 9 Ref.

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Descriptors: *Information exchange, *Rural areas, *Water quality control, Public relations, Public participation, Public health, Attitudes, Surveys, Publications, Drinking water, *Water supply, Eutrophication, *Vermont, Local governments, Water treatment.

Two experiments in improving the information gap between rural Vermont water consumers and state agencies are described. Mann (1974) used an information display board, a survey of health officers, a health officers' conference, and a 3-month newspaper information compaign. Results indicated that people would take action to assure that their water supply passes minimum standards if they had proper information. A model news release was successful in reporting water quality problems to the public; it required only filling in blanks with the appropriate data. Meetings and training sessions for town health officers significantly reduced errors and problems in sampling water supplies. Neiman prepared two publications to help inform rural water users of water quality problems and solutions. 'A Handbook for Rural Water Users' explains the nature of drinking water standards, reasons for these standards, dangers and results of not meeting the standards, and cost effective alternatives for improving water quality. 'A Layman's Guide to Eutrophication' provides information on one of the subjects least understood by town officials. Obstacles to improvement of rural water supplies were lack of information exchange between local officials and consumers, fragmentation of agencies into diverse departments, and public apathy. (Cassar-FRC)
W82-04350

WHEN A WATER SUPPLY WENT BAD.
For primary bibliographic entry see Field 5C.
W82-04357

CONSIDERATIONS ON ORGANIC MATTER IN DRINKING WATER TREATMENT,
Municipal Water Works of Rotterdam (Netherlands).
J. J. Rook, A. Graveland, and L. J. Schultink.
Water Research, Vol 16, No 1, p 113-122, January, 1982, 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Organic matter, *Chlorinated hydrocarbons, *Activated carbon, *Water treatment, Drinking water, Design criteria, Surface water, *Netherlands, Performance evaluation, Organic carbon, Water quality, Ozonation, Chlorination, Adsorption, Water treatment facilities.

The efficiency of organic matter removal was evaluated in four water treatment systems in the Netherlands. All systems used stored surface water as the raw water source. Performance varied according to the parameters chosen. Most groups of parameters gave incomplete information. The classic parameters, COD, permanganate, ultraviolet extinction, and color, may give false impressions of removal efficiencies when oxidative treatments are involved. The instrumental total organic carbon (TOC) method is the most reliable in this group. The parameters, taste, color, and odor, also give limited information on water quality. A method for determining biodegradable organic matter (AOC) introduced by van der Kooy (1978) is the best parameter to judge efficiencies of water treatment chains from the bacteriological aspect. Toxic material parameters include chlorinated organic compounds and organically bound chlorinated compounds adsorbable on activated carbon (AOCl). In designing drinking water treatment trains, water should have minimum: (1) taste and odor, determined by organoleptic means, (2) toxic substances, determined by halogenated organic compounds (AOCl), and (3) bacterial count, determined by the AOC test and 22 C bacterial counts. This procedure helps avoid overtreatment. Parameters (bacterial counts, AOC, trihalomethanes, and AOCl) are given for the four treatment systems: (1) prechlorination plus granular activated carbon, Rhine River and polder water, (2) prechlorination and powdered activated carbon, Meuse River, (3) ozonation and biological filtration, highly colored water, and (4) ozonation and granular activated carbon, Meuse River, (Cassar-FRC)
W82-04374

LEAK DETECTION PROGRAMS RECOVER REVENUES,
Community Consultants, Inc., Provo, UT.
For primary bibliographic entry see Field 3D.
W82-04375

GRANULAR ACTIVATED CARBON INSTALLATIONS,
Culp/Wesner/Culp, Cameron Park, CA.
R. L. Culp, and R. M. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102492, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-177, October, 1981. 9 p, 1 Fig, 1 Tab.

Descriptors: *Activated carbon, *Water treatment, *Cost analysis, *Drinking water, *Adsorbents, Wastewater treatment, Reactivation, Odor control, Color removal, Organic compounds.

On January 9, 1978, EPA proposed the use of granular activated carbon (GAC) as a means of treating drinking water. Questions have been raised regarding EPA's cost estimates for GAC use. As part of studies designed to establish water supply unit process costs, GAC treatment design criteria, performance, and cost data were compiled from 22 operating municipal and industrial GAC installations that treat water and wastewater, and that process food and beverage products. Results indicate that a substantial number of GAC installations have been operating successfully for many years. Although long-term use of GAC and powdered activated carbon by municipal waterworks and industries has been widespread, no adverse health effects have been reported. GAC treatment of public water supplies to remove trace organics is fairly new, but GAC treatment of public water supplies for taste and color control or for color removal is practiced in about 46 cities in the US. Pilot plant testing of GAC adsorptive and reactivation characteristics in municipal water treatment plants can be combined properly with the known costs of GAC systems in wastewater treatment to yield a design basis and preliminary cost estimates that are satisfactory for developing water treatment projects. (Moore-SRC)
W82-04391

EFFECT OF HALOGENS ON GIARDIA CYST VIABILITY,
Oregon Univ. Health Sciences Center, Portland.
E. A. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102294, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-174, October, 1981. 3 p, 2 Ref. R-806032.

Descriptors: *Giardia, *Disinfection, *Drinking water, *Water treatment, *Chlorination, *Iodine, Water temperature, Hydrogen ion concentration, Protozoa, Parasites, Halogens.

The vehicle for spreading epidemic giardiasis is drinking water. The development of a method to induce the excystation of Giardia cysts has made possible, for the first time, a reliable method of determining Giardia cyst viability, and thus, the ability to determine whether a given procedure kills these cysts. Using this method, the effects of halogens on thee cysts of G. lamblia were tested. In one set of experiments, chlorine was tested under a variety of conditions including chlorine concentrations, temperature, pH, and chlorine-cyst contact time. Within the range of variables studied, the ability of cysts to excyst after treatment was affected by each of these variables. Percent excystation decreased with: increasing chlorine concentration; increasing temperature; decreasing pH; and increasing contact time. In a second set of experiments, six small-quantity water disinfection methods were tested. Two methods (Halazone and bleach) employed a form of chlorine, and four methods (Globaline, EDWGT, and elemental iodine in tincture and in saturated form) involved some form of iodine. Halazone and EDWGT inactivated all of the cysts under all test conditions. Bleach, Globaline, and tincture of iodine only failed to inactivate all cysts under one set of conditions: in clear water at 3 C. Saturated iodine failed to inactivate all of the cysts in either clear or cloudy water at 3 C, but inactivated all cysts at 20 C. (Moore-SRC)
W82-04401

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 5A.
W82-04413

COAGULATION MECHANISMS: AN ELECTRON MICROSCOPIC STUDY USING ALUMINUM SULFATE,
Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
T. Ishibashi.
Journal of the American Water Works Association, Vol 72, No 9, p 514-518, 1980. 8 Fig, 9 Ref.

Descriptors: *Turbidity, *Water treatment, Drinking water, Potable water, *Coagulation, Clays, *Aluminum sulfate, Zeta potential.

A transmission electron microscopic study was performed to obtain visual data on the mechanism of coagulation. The findings call into question the validity of the double-layer theory of coagulation on clay colloid. Shokozan clay, classified mineralogically as dickite clay, was selected for the study. After the clay solution settled for 24hr, microscopic inspection revealed particles several micrometers in diameter among the particles remaining in suspension. Further treatment of the suspension was rendered. The primary stage of coagulation of the clay colloid was reached by adsorption of soluble aluminum hydrolysis ions and by the chemical reactions producing aluminum hydroxide on the surface of the clay particles. The coagulation could be carried out at a zeta potential of -26.6 mV, much lower than the typical values reported in the literature, suggesting that coagulation was not directly related to the zeta potential value. At this low dosage of alum the coagulated particles and the uncoagulated particles coexisted in the suspension. Adsorption and chemical reactions between soluble aluminum hydrolysis ions and the surface of clay particles seem to be completed instantaneously after the alum dosing. Whether aluminum hydroxide is formed in films on the colloids or on independent particles may have a significant effect on the floc growth. The double-layer theory holds that the zeta potential and the colloid stability are correlated, and that a sufficient reduction of zeta potential is needed to achieve coagulation. In this study coagulation was carried out even with high zeta potential, indicating that adsorption of potential determining ions and bridging explain the observed phenomena better than the double-layer theory. (Baker-FRC)
W82-04423

COAGULATION: EXPERIENCES IN ORGANICS REMOVAL,
Minnesota Univ., Minneaplis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, and T. K. Field.
Journal of the American Water Works Association, Vol 72, No 8, p 476-483, August, 1980. 17 Fig, 1 Tab, 10 Ref.

Descriptors: *Water treatment, *Coagulation, Organic compounds, Trihalomethanes, Sludge, Alum, Acidity, Temperature effects, Flocculation, Sampling, *Mississippi River, *Minneapolis, Minnesota.

Coagulation tests were run of water samples taken from the Mississippi River close to the point of extraction for the Minneapolis water treatment plant. The water is high in organic content, with dissolved organic carbon concentrations ranging between 10 and 16 mg/liter during the course of the study. Turbidity ranged between 2 and 25

NTU. The coagulation process with alum as the sole coagulant was found to be capable of achieving significant organics removal from the Mississippi River water. The removals were found to be strongly pH and dose dependent. Organics absorbing ultraviolet light are removed more effectively by coagulation. Tests conducted on unconcentrated and reconstituted Mississippi River water at various times indicate that the organics removal was very reproducible. The only significant variation was noted when low alum doses were used in high turbidity waters. The influence of varying flocculation times on turbidity and organics removal was examined for three river water samples. Tests were also conducted to determine whether the organics removal performance could be improved by altering the way in which the coagulant was added to the river water. The results essentially indicated that there was no benefit to a two-stage coagulation process. Similar results were obtained with the three- and four-stage studies. The recycling of sludge to supplement an alum dose did not improve organics removal compared to controls receiving no recycled alum sludge. It was concluded that the most important variables influencing organics removal by alum coagulation are alum dose and pH. (Baker-FRC)
W82-04424

CONTROL OF TRIHALOMETHANES IN DRINKING WATER,
Louisville Water Co., KY.
D. T. Duke, J. W. Siria, B. D. Burton, and D. W. Amundsen.
Journal of the American Water Works Association, Vol 72, No 8, p 470-476, August, 1980. 5 Fig, 5 Tab.

Descriptors: *Drinking water, *Organic compounds, Water quality, *Water treatment, Potable water, *Trihalomethanes, Activated carbon, Hydrogen peroxide, Chlorination, Ammonification, Ammonium.

The implementation of effective methods for the control of trihalomethanes (THM) is neither impossible nor overly difficult. Methods such as ammoniation for hindering THM increases after chlorination have been explored and the technology is available, as is the technology for other methods of disinfecting water supplies without forming significant amounts of THMs. While these do pose an inevitable cost problem, they also present solutions to the major problem. Each plant must survey its individual needs for THM control and select the most appropriate technology for the job. One test that has been widely used to study the effect of chlorination on source waters is the trihalomethane formation potential test (THMFP). Temperature, pH, chlorine dosage and chlorine contact time are the critical factors in this test. Since chlorine contact time is critical in THM formation, a system that reduces this contact time may feasibly reduce THM formation. The THMFP of the source water increases as the temperature of the water increases, peaking during the summer months. Use of ammoniation in place of chlorination offers an effective means of reducing THM growth. The use of chloramines, ozone, and hydrogen peroxide as disinfectants that do not form THMs should also be considered. Hydrogen peroxide, a dechlorinating agent, when used in conjunction with chlorine might provide the right combination to achieve complete disinfection and prevent THM formation simultaneously. The cost of chemicals for this treatment would be significantly higher than for ammoniation, but the results are much more successful. Suggested use of granular activated carbon pertains to a wider scale removal of organic compounds than just THMs. (Baker-FRC)
W82-04425

THE MONOCHLORAMINE-GAC REACTION IN ADSORPTION SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Environmental Engineering.
B. R. Kim, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 488-490, August, 1980. 3 Fig, 11 Ref.

Descriptors: *Adsorption, *Activated carbon, Granular activated carbon, Simulation, Model studies, Water treatment, Drinking water, Potable water, *Chlorination, Organic compounds, *Monochloramine, Chemical reactions.

This paper deals with the reaction kinetics of monochloramine, a critical component of chlorine residual, with granular activated carbon. The results show the effect of influent concentration, flow rate, contact time, and carbon particle size on the GAC-ammonium chloride reaction. Monochloramine reacted slowly with GAC by comparison to the rates at which free chlorine and dichloramine react. After an acclimation period, the effluent ammonium chloride concentration from a GAC contactor reaches a steady state value if such influent conditions as ammonium chloride concentration, flow rate and other factors do not change. The reaction rate at steady state is slower than the initial rate. At steady state the reaction rate for ammonium chloride is very slow if the solution concentration is below about 1 mg/liter as chlorine. Very long contact times are therefore required if the concentration is to be reduced below detectable levels. (Baker-FRC)
W82-04426

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,
Montgomery (James M.), Pasadena, CA.
R. R. Trussell, and A. R. Trussell.
Journal of the American Water Works Association, Vol 72, No 8, p 458-470, August, 1980. 21 Fig, 5 Tab, 51 Ref.

Descriptors: *Water supply, *Organic compounds, Pollutant identification, *Drinking water, Potable water, *Water treatment, Reulations, Evaluation, Reviews, *Synthetic organics.

An approach is outlined which a water utility might employ to evaluate the purity of its water source, review the effectiveness of its current treatment, assess the exposure of the consumer to risks, study the feasibility of various courses of action, and implement a final plan. The task of dealing with synthetic organics can be divided into six parts: source evaluation, risk assessment, feasibility analysis, scheduled periodic surveillance, cost-benefit analysis, and implementation. Tasks required to evaluate the integrity of the quality of a water source are the source survey and the source analysis. Once source evaluation is complete, an assessment must be made of the health risk imposed on the population consuming the water. Potential synergistic and antagonistic effects must be considered between different compounds. If the results of the source evaluation and risk assessment are not satisfactory, a feasibility study must be conducted to determine the most effective means of providing a safe water supply. Five basic alternatives may be considered if the water supply is not adequately protected: find a protected source; eliminate the contaminants; use a combination of off-line storage with river supplies so that water can be drawn off during periods of good quality; treat the water supply to remove the materials of concern; and install dual distribution systems and use water from a protected source for domestic supply and water from the unprotected source for less exacting uses. Treatment may include aeration, coagulation, oxidation, biological processes and adsorption. (Baker-FRC)
W82-04427

REMOVAL OF TOTAL ORGANIC HALOGEN BY GRANULAR ACTIVATED CARBON ADSORBERS,
Illinois Univ. at Urbana. Champaign. Dept. of Civil Engineering.
J. E. Quinn, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 483-488, August, 1980. 14 Fig, 3 Tab, 6 Ref.

Descriptors: Water quality, *Organic carbon, Adsorption, *Activated carbon, *Halogens, Hazardous materials, *Water treatment, *Monitoring, Drinking water, Potable water, Water supplies.

This study was undertaken to show the potential for using total organic halogen (TOX) measurements to determine the degree of saturation of activated carbon adsorbers. Humic substances, a major constituent of natural waters, were chlorinated and applied to laboratory columns for this purpose. Samples taken at several times from experimental adsorbers at Jefferson Parish, Louisiana, were also evaluated. The results of the study showed that for these adsorbates TOX buildup on the carbon was gradual and consistent, and that measurement of the TOX profile in the adsorber at different times can be used to determine when the adsorption capacity has been depleted and replacement or regeneration is needed. Determination of the TOX profiles at Jefferson Parish showed a gradual saturation of adsorption capacity at all depths with time. Thus it appears that measuring the group parameter total organic halogen may be an acceptable alternative to analyzing specific compounds in order to monitor water quality and the efficiency of water treatment processes for removing potentially hazardous organics. (Baker-FRC)
W82-04429

EFFECTS OF CHLORINE CONCENTRATION ON THE STRUCTURE OF POLIOVIRUS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
M. E. Alvarez, and R. T. O'Brien.
Applied and Environmental Microbiology, Vol 43, No 1, p 237-239, 1982. 1 Fig, 4 Ref. OWRT-A-066-NM.

Descriptors: *Viruses, *Chlorination, Wastewater treatment, *Water treatment, Chemical reactions, Poliovirus.

Relationships are explored between chlorine concentration, loss of viral infectivity and viral composition in aqueous medium changes. Poliovirus type 1 (Mahoney) was used in the study. At chlorine concentrations up to 0.4 mg/liter, there were no major changes in the poliovirus sedimentation coefficients, although virus inactivation was 38%. At chlorine concentrations of 0.8 mg/liter or higher, there was a shift of the virus sedimentation coefficients from the 156S value associated with intact particles to 80S, which was shown to represent structures lacking RNA. The percentage of counts associated with empty capsid peaks did not correlate with percent inactivation values. These results indicate that changes in virus composition and structure are dependent on the initial chlorine concentration and that these changes are not the primary cause of virus inactivation. Chlorine concentrations in excess of 0.8 mg/liter apparently lead to reactions within the virus particles which can result in separation of the viral components. (Baker-FRC)
W82-04525

WATER IN PHARMACEUTICALS AND COSMETICS INDUSTRIES,
Chiltern Water Treatment Co. (England).
R. W. Hill.
Effluent and Water Treatment Journal, Vol 21, No 11, p 515-517, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Water quality, *Industrial water, *Water treatment, Reverse osmosis, Filtration, Membrane processes, Standards, Bacteria, Water use, *Pharmaceutical industry, *Cosmetic industry.

The treatment of water which appears in the products of the cosmetics or pharmaceuticals industries is discussed. In the British Pharmacopoeia two categories are specified for water used by the pharmaceutical industry, purified water and water for injections. The major difference between these two categories is that purified water refers to chemical impurities, while water for injection must also be free of biological contaminants. With the exception of injection and infusion solutions, other products will be exposed at some time to the atmosphere and thus to possible biological contamination. It is usually necessary to use purified water even for apparently non-critical cosmetics because contaminants may interfere with the manufacturing process or cause deterioration in the

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appearance of the product. Ion exchange is fast becoming the most common method of preparing purified water on the commercial scale. Reverse osmosis is able to remove non-ionized contaminants and is becoming increasingly popular. However, this method alone will not usually effect sufficient removal to meet purified water requirements, and it is usual to employ a mixed bed ion exchange polishing unit downstream. Reverse osmosis can be used for producing sterile water, but there is some recent evidence that certain small bacteria, viruses and pyrogens can pass through the semipermeable membranes. Storage of high purity water is difficult, as this substance is an exceptionally good solvent. Care must be taken in selecting construction materials for purified water systems. Polishing filters should be employed at the points of use whenever possible. (Baker-FRC)
W82-04533

THE NECKAR AS A SOURCE OF PROCESS AND RESERVE WATER (DER NECKAR ALS LIFEFERANT VON BETRIEBS- UND RESERVEWASSER),
Technisch Werke der Stadt Stuttgart (Germany, F.R.).
K. E. Oehler.
GWF-Wasser/Abwasser, Vol 122, No 12, p 566-571, 1981. 2 Fig, 5 Tab. English Summary.

Descriptors: *Water supply, *River water, *Municipal water, Water quality, Neckar River, *Stuttgart, Germany, Impaired water use, Ammonium, Process water, Industrial water, Water distribution, *Water treatment, Potable water, Drinking water, Chlorination.

Following completion of the Lake Constance drinking water supply for the city of Stuttgart, the Berg water treatment plant on the Neckar River was kept in operation to supply industrial process water, to serve as an emergency supply for the city if needed, and to reduce the demand on the piped supply. Berg water is used in a power plant, the gas plant, the city laundry, the railway, the parks and fountains of the city, and municipal air conditioning facilities. The quality of Neckar water is still monitored regularly. The principal problem pollutants in the Neckar at present are high ammonium concentrations and trihalomethanes. Detailed analyses of chemical composition for 1980 revealed significant changes only during extremely high and low flow. During high flow sludge transport was noted, and enrichment of wastewater constituents occurred during low flow. Nevertheless most water quality parameters still fell within the highest quality class, except for phosphate and ammonium concentrations. The water treatment of the Neckar supply comprises sub-breakpoint chlorination, aluminum sulfate flocculation, settling and rapid filtration. Powdered activated carbon, slow sand filtration and charcoal filtration are used only in the case of drinking water. Low-level chlorination is the final step. This simplified treatment and the short distribution pathways make it possible to supply the process water at half the cost of normal drinking water. (Carroll-FRC)
W82-04546

TREATING TASTE AND ODOUR PROBLEMS USING OZONE AND ACTIVATED CARBON,
Degremont Infilco Ltd., Rueil-Malmaison (France).
R. Cyr, and Y. Richard.
Water and Pollution Control, Vol 119, No 12, p 15-17, December, 1981.

Descriptors: *Ozone, *Activated carbon, *Taste, *Odor control, Water treatment, Adsorption, Filtration, Clarification, Organic matter, Monsang-sur-Seine, France, *Paris.

The 13.9 mgd Monsang-sur-Seine plant suplying water to Paris suburbs has incorporated granular or powdered activated carbon and ozone into the treatment process. The ozone treatment step takes place between the clarification-sand filtration step and the activated carbon treatment. This sequence eliminates taste and odor in the water prolongs the useful life of the carbon. This procedure produces good quality water in spite of the variable quality of the raw river water, which is occasionally polluted, especially during low flow in summer. (Cassar-FRC)
W82-04553

PURIFICATION OF SURFACE WATERS (REINIGUNG VON OBERFLACHENWASSER),
Boliden-Knapsack G.m.b.H., Hurth-Knapsack (Germany, F.R.).
G. K. Kohler.
Wasser, Luft und Betrieb, Vol 25, No 11, p 10-12, 1981. (No English Summary).

Descriptors: *Water treatment, *Drinking water, *Filtration, Flocculation, Chemical coagulants, Flotation, Separation techniques, Magnetic separation, Phosphate removal, Surface water, Tegeler Sea, *Berlin, Germany.

Increasing demands for water necessitate the use of increasing amounts of surface water for drinking water preparation. Numerous studies have been conducted on improved methods for surface water treatment, including especially flocculation. Phosphorus removal is a major goal of flocculation and of combined chemical precipitation and filtration. The use of a two-filter system with a second flocculation step between the filters greatly improves phosphate removals. Including a container flocculation step before the filter increases filter life and phosphate retention without excessive chemical addition. This system was applied to cleanup of water obtained from the heavily contaminated Tegeler Sea near Berlin. Sludge retention was a substantial problem during the trial runs. Tube flocculation could markedly increase floc removal efficiency. Magnetic flocculation is another possibility for increasing flocculation efficiency. Flotation may be preferable to flocculation in special circumstances. Nevertheless available systems are not yet perfect in efficiency. (Carroll-FRC)
W82-04577

SELECTIVE REMOVAL OF FLUORIDE, ARSENATE AND PHOSPHATE IONS FROM WATER (SELEKTIVE ENTFERNUNG VON FLUORID-, ARSENAT- UND PHOSPHAT-IONEN AUS WASSER),
Institut Fresenius, Chemische und Biologische Laboratorien GmbH, Taunusstein-Neuhof (Germany, F.R.).
W. Fresenius, and W. Schneider.
Wasser Luft und Betrieb, Vol 25, No 11, p 14-15, 1981. 12 Ref. (No English Summary).

Descriptors: *Water treatment, *Fluoride, *Adsorption, Aluminum oxide, Arsenic compounds, *Phosphate removal, Drinking water, Hydrogen ion concentration, Aluminum compounds.

Available waters in some localities exceed the maximum permissible levels for fluoride, phosphate and arsenate, and therefore require treatment prior to consumption as drinking water. Special grades of aluminum oxide were developed as fluoride adsorbents and tested in a pilot scale installation. Residual fluoride contents below 1 mg/1 were obtained using initial waters with fluoride contents of 3 mg/1 and 10 mg/1 and pH values of 6.3-6.5. Filter lifetimes were about 30 days. About 10 liters of 2 N sodium hydroxide per kg aluminum oxide were required for regeneration. Accumulation of fluoride by the adsorbent from the rinse water can be prevented by using rinse water with pH values in excess of about 7.5. Fluoride ion removal is not selective, but hydrogen arsenate and hydrogen phosphate are also removed to a high degree. Changes in other mineral constituents were not observed. The increase in aluminum content in the filtered water samples amounted to about 0.1 mg/l. (Carroll-FRC)
W82-04578

SLOW-SAND TEST-BEDS HELP REFINE DESIGN,
A. Raman, G. Singh, and J. L. Nagpal.
World Water, Vol 4, No 12, p 44-45, December, 1981. 2 Fig.

Descriptors: *Water treatment, *Rural areas, *Pilot plants, *Sand filters, Filtration, Water supply, Raw water, Filters, Separation techniques, Control systems, Chlorination, Design criteria, Abub Shahar, *India.

In designing the Abub Shahar water treatment demonstration plant in India, the lack of skilled staff and possibility of discontinuous terminal chlorination were taken into account. The filters function mainly for polishing and bacterial purification. Raw water in a storage tank is filtered 24 hr per day by four circular filters with one as a standby. The filtered water is chlorinated and held in two clearwater tanks until distribution to the rural villages. The Abub Shahar village demonstration plant has experienced vagaries of electric power supply since it began operation in June of 1979. Although backup diesel generators can be used, extra capacity capabilities could be supplied to the plant's different units to satisfy about 66% of design demand during these adverse periods. The backup filter is being operated constantly, and the high-level tank lacks a float valve on the outlet. A partially above ground filter would have been more appropriate to facilitate scouring of supernatant water. A master sluice valve to control raw water pumping and overflows in all the filters are suggested to improve flow regulation. A separate supernatant scour-out box combined with filter overflow and a modified outlet arrangement incorporating rate-limiting and measuring orifices in the backfilling pipe are also proposed. (Geiger-FRC)
W82-04614

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
A. Grohmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 194-209, 1981. 15 Fig, 3 Tab, 16 Ref.

Descriptors: *Water treatment, *Flocculation, *Design criteria, Wastewater treatment, Water treatment facilities, Laboratory studies, Separation techniques, Chemical coagulation, Pilot plants, *Phosphate removal, Industrial wastewater, *Water pollution control.

The possibility of performing flocculation in pipes offers a means of significantly accelerating the flocculation process, since the velocity gradients in pipes enhance agglomeration of microflocs. A pipe length of 40 m will allow an adequate safety margin for maintenance of flocculation, since a steady state of floc growth versus breakup is reached in approximately 20 m. Adequate colloid and precipitation products destabilization is required. In addition to rising velocity gradients, addition of anionic polyacrylamides will also increase floc size. The design selected must provide sufficient turbulence to bring microflocs into contact with one another, but not to destroy flocs already formed. Design and operation data are presented for a trailer-mounted water treatment pilot plant and an industrial water treatment plant. Data are also tabulated for pipe flocculation systems ranging from laboratory tests with model colloids to full-scale water and wastewater treatment plants. Pipe sizes ranged from 8 to 600 mm diameter. Typical values obtained were flocs of 2-3 mm with a settling rate of 10 m/hr and a residual turbidity (after 10 min standing) of 1.5 formazin units, at an anionic polyacrylamide addition rate of 0.5 g/cu m and a mean flow velocity gradient of 70/sec. (Carroll-FRC)
W82-04615

TANZANIA'S MASTER WATER PLAN WILL MISS DECADE GOAL,
R. Laishey.
Water, No 42, p 26-27, 1982.

Descriptors: *Developing countries, *Water supply development, Potable water, Drinking water, Water supply, *Tanzania, Shallow wells, Wells.

In 1977, 90% of the rural population of Tanzania was living in village settlements, and the government was attempting to supply them with safe potable water. The country had announced an ambitious water plan in 1977, with a target date of 1991 as the year by which all the rural population would be within 400 meters of safe potable water. In 1973 the first phase of the scheme began, with the drawing up of a master plan for each of the 20 regions of the country. By the beginning of the 1980s, 12 regions were equipped with paster plans, another five were under preparation and for three no plans had yet gotten underway. A Master Plan Coordination Unit was established to oversee the project and gather the needed funding. Officially some six to seven million people or just under 40% of the rural population are now within 400 meters of potable water. In reality the figure may be closer to three to four million. Part of the problem is cost. Experiments are being conducted with cheaper technologies and self-help schemes. It is believed that the shallow well scheme can reach some 50% of the population in rural areas, but shallow wells have serious drawbacks. One well can probably only efficiently serve a village of 1,500 people. Many villages have 2,000 or more people. (Baker-FRC)
W82-04657

COLLOIDAL ORGANICS,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 2, p 65-67, 1982. 2 Fig, 8 Ref.

Descriptors: *Colloids, *Organic matter, Decomposing organic matter, Litter, Taste, *Water treatment, *Water quality, Odor control, Odor-producing algae, Odors, Coagulation.

Relatively high concentrations of organic colloids in a water supply are troublesome and should be removed for the following health and esthetic reasons: taste and odor problems are largely due to colloidal organics, byproducts of algae, diatoms, and actinomycetes, which produce objectional tastes and odors; humic and fulvic acids are precursors of chloroform; colloidal organics produce undesirable colors in water; colloidal organics cause fouling of anion exchangers and interfere with the demineralization of water; metal complexes of organic colloids strongly influence metal distribution between the dissolved and particulate state; the presence of colloidal organics can shield waterborne pathogens from disinfection treatment and can create problems associated with biological quality of treated water; and colloidal organics interfere with oxidation and removal of iron and manganese from water. Most organic substances produced by plants and animals in lakes and rivers and those brought there from the outside, such as leaf litter, are eventually decomposed through the metabolism of various aquatic organisms such as bacteria and fungi. Since the electrically charged surfaces of colloidal particles cause them to repel one another and maintain the stability of a colloidal dispersion, neutralization of the charged surfaces would permit the colloidal particles to come together and be removed from a water supply. The removal of colloids in this manner can be accomplished by coagulation. Various hypothetical models have been proposed to explain the destabilization and initial aggregation of colloidal matter by the addition of coagulants. (Baker-FRC)
W82-04689

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,
Connecticut Water Co., Clinton.
J. E. Lebert, Jr.
Journal of the New England Water Works Association, Vol 95, No 4, p 267-270, December, 1981.

Descriptors: *Water conveyance, *Maintenance, Water distribution, *Water mains, Water supply systems, Management planning, Materials, Iron, Corrosion, Saline water, *Guilford-Chester Division, Connecticut Water Company, *Connecticut.

A review is presented of the last 15 years of year round distribution system maintenance carried out by the Connecticut Water Company, Guilford-Chester Division. During this time over 37,000 feet of 2, 4 and 6 inch cast iron and galvanized iron main was replaced with 8 inch or larger ductile iron mains. All new water mains in the salt water areas have been transilwrapped for protection. Larger mains have provided greater fire protection and a better quality of water, as they are all cement lined. Many dead ends were also tied in to improve fire protection and quality. Every service on the replacement mains was also replaced with copper tubing or plastic tubing. Crew size has been kept low, primarily due to the replacement vs repair program. Work is very seldom interrupted to make an emergency repair. A winter and spring maintenance program has been devised to make the best use of the time available. A program of replacing or repairing bridge crossing, culvert crossings, and river crossings has also been started. The policy aims at repairing or replacing before a problem occurs. (Baker-FRC)
W82-04699

REACTION OF OZONE WITH TRANS,TRANS-MUCONIC ACID IN AQUEOUS SOLUTION,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert.
Water Research, Vol 14, No 11, p 1637-1643, November, 1980. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Ozone, *Organic compounds, *Oxidation, *Water treatment, Aromatic compounds, Muconic acid, Peroxides, Chemical degradation, Degradation products, *Ozonation, Drinking water, Chemical reactions, Phenols, Kinetics.

Ozonation of trans,trans-muconic acid in aqueous solution at pH 3 leads to the formation of fumaric acid aldehyde, glyoxal, glyoxylic acid and formic acid. As the reaction progresses, these are oxidized to the stable end products oxalic acid, mesoxalic acid and carbon dioxide. Hydrogen peroxide has been observed, in addition to unstable organic peroxides. Organic peroxides are not observed in the case of ozonation at pH 7-8, and the amounts of organic peroxides formed in this case are smaller than at pH 3. Up to the point of complete elimination of muconic acid the specific ozone consumption was 3.2 mmol ozone per mmol acid. Quantitative analysis of the oxidation products indicated that the ring opening products initially formed are further oxidized during ozonation, resulting in very low steady state concentrations in the course of ozonation at high ozone doses and low initial concentrations of aromatics to be oxidized. (Carroll-FRC)
W82-04731

5G. Water Quality Control

WATER MANAGEMENT IN ONTARIO,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 6E.
W82-04259

STRATEGIES TO CONTROL NONPOINT SOURCE WATER POLLUTION,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
J. J. Peirce.
Water Resources Bulletin, Vol 16, No 2, p 220-225, April, 1980. 1 Tab.

Descriptors: *Water pollution control, *Nonpoint pollution sources, Regulations, Environmental management, *Regional planning, Planning, Water quality control, Management, Water policy, Research priorities, Monitoring, New York, Virginia, Wisconsin, Urban runoff.

Strategies for nonpoint source water pollution control are discussed for three representative states, Virginia, New York, and Wisconsin. The most significant nonpoint pollution source in these states is urban storm water runoff, including combined sewer overflows. Others are silviculture activities, construction, mining activities, on-site wastewater treatment facilities, disposal of municipal and idustrial sludge and refuse, and agricultural runoff. A complete range of control strategies is illustrated, from voluntary compliance to strict regulations. Virginia favors voluntary action, Wisconsin plans to implement strict regulations if voluntary compliance is ineffective, and New York favors voluntary compliance combined with some regulations. A study of the programs and agencies in these states indicates: (1) nonpoint sources of pollution are a major component of overall water pollution, (2) technology exists to control these problems, (3) present control programs are not always technologically sound or cost effective, and (4) existing control programs will work only if meaningful actions take place in the future (voluntary compliance and effective implementation of regulations). (Cassar-FRC)
W82-04261

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,
Brown and Caldwell, Sacramento, CA.
For primary bibliographic entry see Field 5C.
W82-04278

USE OF ACTIVE ALUMINA FILTRATION FOR REMOVING PHOSPHATES FROM SMALL INFLUENTS INTO AN IMPOUNDING RESERVOIR (ANWENDUNG DER AKTIVTONERDEFILTRATION ZUR ELIMINERUNG VON PHOSPHATEN AUS KLEINEN TALSPERRENZULAUFEN),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, S. Fberle, D. Donnert, H. Struwe, and A. Wilhelms.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 180-187, 1981. 9 Fig, 4 Tab, 7 Ref.

Descriptors: *Watershed protection, *Reservoirs, *Phosphate removal, *Fish ponds, Adsorbents, Activated alumina, Filtration, Impoundments, Nonpoint pollution sources, Aluminum compounds, Nitrification, Ammonium, Receiving waters, Germany.

Fish ponds can represent significant sources of pollutants, especially phosphorus compounds and ammonia, in receiving waters. In 1987-1980 a hatchery located on the Derenbach introduced 55-65 kg of total phosphorus per year into an impounding reservoir located on the Wahnbach, contributing significantly to algal growth in the reservoir. Gravity filtration units were designed and inserted in the fish pond effluent line. The filters had a total surface area of 24 sq m and contained 19.8 metric tons of activated alumina. Filtration speed was conrolled to achieve satisfactory phosphate elimination and ammonium removal by nitrification. Filters were back-washed every 4 weeks with pond water; the back-wash water and sludge were returned to the main pond. Over the 10-month operation period, average orthophosphate removals of 83% were achieved, and average total phosphate removals of 77%. The effluent orthophosphate concentration was approximately equal to the desired value of 50 microg/liter. About 40% of the total organic carbon was also removed. Unexpectedly high ammonium ion removals were also attained, ranging up to 90%. No increase in aluminum level was recorded in the effluent. lgal clogging of the filter can be reduced by excluding light. Operating costs were estimated at 0.05 German Marks per cu m of filtered water. The filtration unit is still operating satisfactorily after one year. (Carroll-FRC)
W82-04281

ANALYTICAL QUALITY CONTROL,
D. Hunt.
Water, Vol 41, p 17-19, November, 1981. 3 Fig.

Descriptors: *Quality control, *Water analysis, Pollutant identification, Precision, Accuracy, Standard deviation, Laboratories, *Water quality control.

Analytical quality control in the water industry is necessary because there are many sources of ana-

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lytical error--the analyst, the method, instruments, and contamination. The Water Research Council recommends a method for achieving comparability of analytical results from several laboratories. A working group defines the analytical objectives, chooses the most suitable method or develops a new one, ensures that instructions for methods are complete and clear, estimates standard deviation, compares standard solutions used by all laboratories, ets up control charts for systematic analysis of known solutions, and estimates the bias of each laboratory. A group of laboratories using quality conrol wqs far superior in analyzing a known lead solution when compared with a group not applying a quality control scheme. (Cassar-FRC)
W82-04345

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,
Snake River Conservation Research Center, Kimberly, ID.
For primary bibliographic entry see Field 4D.
W82-04358

WATER-QUALITY PROBLEMS AND MANAGEMENT OF AN URBAN WATERFOWL SANCTUARY,
Wisconsin Univ. Green Bay. Coll. of Environmental Science.
H. J. Harris, Jr., J. A. Ladowski, and D. J. Worden.
Journal of Wildlife Management, Vol 45, No 2, p 501-507, 1981. 8 Fig, 22 Ref.

Descriptors: *Ponds, *Eutrophication, Nutrients, Birds, Water birds, *Waterfowl, *Water pollution sources, Wildlife habitats, Wildlife, Wildlife conservation, *Beach Wildlife Sanctuary, Green Bay, Wisconsin, *Water quality control.

The effects of waterfowl on water quality of an urban waterfowl sanctuary and the effectiveness of dredging as a renovation technique were investigated. The study was conducted at the Bay Beach Wildlife Sanctuary, Green Bay, Wisconsin. The sanctuary is a complex of interconnected manmade ponds surrounded by urban open space, including wetlands. Sources of water for all ponds are rain, runoff, and groundwater, with no connection between the ponds and Green Bay. Waterfowl use was estimated by direct counts several times a month over a 4 year period, usually taken at the time of water sampling. There were large differences in intensity of waterfowl use between the two ponds selected for study, one of which (N) was dredged, while the other (L) served as control. The estimated average annual use of N over a 4 yr period was 180,000 waterfowl days, whereas the use of L was 31 waterfowl days. Calculated annual loading from waterfowl in N amounted to 378 kg of total phosphate, 378 kg total nitrogen, and 7,830 kg of total solids. For L, comparable fiures were 0.065 kg phosphate, 0.065 kg total nitrogen, and 1.35 kg total solids. A sharp decrease in total phosphate and nitrate-nitrogen was noted in N the year following dredging. A marked decline in chlorophyll a was also noted in N after dredging and was correlated with decrease in the number of phytoplankton units/liter of water in the year following dredging. Diversity of phytoplankton, however, increased. While it may be assumed that waterfowl act as a nutrient source and bring small ponds to eutrophication, the key finding of this study was that eutrophication can and does occur rapidly under certain conditions. This is critical in the design and operation of waterfowl urban sanctuaries. (Baker-FRC)
W82-04384

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,
Illinois State Water Survey, Urbana.
T. A. Butts, and R. L. Evans.
Circular 145, 1980. 69 p, 7 Fig, 24 Tab, 18 Ref, 7 Append.

Descriptors: *Dams, *Flow control, *Reservoir releases, *Dissolved oxygen, *Aeration, *Spillway gates, Discharge coefficient, Water quality, Weirs, Locks, Flow measurement, Spillways, Diversion, On-site data collections, *Water quality control, *Illinois waterway dams.

One of the most obvious and direct effects dams have on water quality is the creation of abrupt changes in dissolved oxygen (DO) concentrations. This study's main objectives were to gather physical and chemical data for use in a dam aeration calibration procedure based on a weir formula developed in Great Britain, and to evaluate the effects of increased Lake Michigan diversion water on the dam aeration characteristics. On-site DO and temperature measurements were taken above and below flow release structures and in calibrated weir boxes at seven dams. Water flowing over weirs or through head-loss control structures, such as Tainter and sluice gates, can be aerated or deaerated depending upon the ambient upstream DO concentration. Smaller gate openings consistently had greater reaeration capacities (approximately twice the oxygen transfer efficiency) than larger openings, i.e., the aeration efficiency is inversely related to opening size. This means more efficient aeration could be achieved by using the smallest opening possible while maintaining a desired downstream flow. For example, if 8 feet of opening is required at Starved Rock, 8 gates opened at one foot would be better than two gates at 4 feet, or two at 3 feet and one at 2 feet. However, dam aeration coefficients derived varied significantly within a dam, depending on the mode of operation, and varied greatly between dams. It was determined that under current operating modes the aeration capabilities of the flow release structures at the dams above the LaGrange and Alton pools will be significantly lowered by increasing diversion to 10,000 cfs. (Atkins-Omniplan)
W82-04388

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5D.
W82-04399

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,
Illinois Natural History Survey, Urbana.
For primary bibliographic entry see Field 5C.
W82-04407

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke.
Water resources Bulletin, Vol 16, No 5, p 921-926, October, 1980. 3 Tab, 28 Ref.

Descriptors: *Eutrophication, *Water pollution prevention, *Lakes, *Linings, Nutrients, *Sediment covers, *Sediments, Bottom sediments, Water resources development, Recreation facilities, Plastics, Macrophytes, Nutrients.

Sediment covering has been suggested for controlling macrophytes and sediment nutrient release in order to effect lake restoration. The application of fly ash to control sediment phosphorus release apparently introduces more problems than it solves and should not be used. The possible adverse effects of fly ash application include high pH, dissolved oxygen depletion, biological reduction of sulfate to sulfide, heavy metal accumulation and toxicity, and physical clogging and crushing of organisms. Plastic sheeting has been suggested as a potentially effective technique to control macrophytes and nutrient release. Sand covered sheeting may also be useful in construction of swimming beaches. The largest scale reported experience with sheeting was the Marion Millpond, Wisconsin, where a black polyethylene sheet was used over ten hectares to control or retard macrophyte regrowth. In March of 1978 a finely porous compound, spun bonded DuPont Typar 3201 and 3202 black polypropylene, was applied to exposed sediments of Country Lake in Ohio. Further evaluation of this project is needed. Polyvinyl chloride has also been used. The use of plastic sheeting for control of macrophytes and sediment nutrient release has received insufficient evaluation to make conclusions about effectiveness, duration, application, and cost problems. Very little published information exists about the use of clays or sand to retard nutrient release or macrophyte growth. Heavier materials such as sand are apparently ineffective, as they sink into flocculent sediments. (Baker-FRC)
W82-04421

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,
Montgomery (James M.), Pasadena, CA.
For primary bibliographic entry see Field 5F.
W82-04427

MODELED IMPACTS OF SURFACE COAL MINING ON DISSOLVED SOLIDS IN THE TONGUE RIVER, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
P. F. Woods.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117771, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-64, October, 1981. 73 p, 3 Fig, 33 Tab, 39 Ref.

Descriptors: *Computer models, *Coal mines, *Strip mines, *Dissolved solids, Leaching, Salinity, Irrigation effects, Streamflow, Irrigation water, Selective withdrawal, Return flow, Reservoirs, *Montana, Tongue River, *Water quality control.

A computer model has been developed for spatial and temporal simulation of streamflow and dissolved solids in the Tongue River from the Tongue River Dam to Miles City, Montana. User-defined plans of surface coal mining and agricultural development permit evaluation of potential changes in dissolved solids resulting from leaching of overburden material used to backfill mine pits and from withdrawal and return flow of irrigation water. Provision is made for simulation runs using increased streamflow from a proposed larger reservoir intended to replace the present Tongue River Reservoir. Simulations at mean streamflow indicated that mining 119,600 acres of federally leased coal tracts may increase by 4.8 percent the present annual dissolved-solids concentration in the Tongue River at Miles City. Simulations using the proposed Tongue River reservoir show substantial reductions in dissolved-solids concentration when paired with similar simulations using the present Tongue River Reservoir. When compared on a per-acre basis for the study area, the dewatering caused by irrigation increases dissolved-solids concentration more than the input of leachates from surface coal-mining operations. (USGS)
W82-04494

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04516

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN-GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),
Tubingen Regierungspresidium (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W82-04551

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,
For primary bibliographic entry see Field 6B.
W82-04554

TELEMETRIC WATER CONTROL SYSTEM OF THE ARTIFICIALLY AERATED MOSEL RIVER,
Landesamt fuer Gewasserkunde, Mainz (Germany, F.R.).
H. Kalweit.
Water Science and Technology, Vol 13, No 11/12, p 645-650, 1981. 4 Fig.

Descriptors: *Telemetry, *Water management, Oxygen, *Aeration, Remote sensing, Computers, Automation, *Water pollution control, Rivers, *Mosel River, Weirs, Spillways, Water pollution sources, Wastewater, Navigation, Plankton, *Germany.

A temporary but substantial deterioration of the oxygen balance has been noted in the Mosel River due to weir steps which were constructed to aid in the use of the river for navigational and hydroelectric purposes. The river is loaded by sewage effluent and self polluted by plankton. Overspill has been provided at the barrages to alow artificial aeration to be carried out, thus increasing the oxygen content of the river water. The overspilling is to the debit of hydropower and should thus be as small as possible but sufficient for river protection. An accurate adaptation to the aeration demand has to be figured temporally and locally. Such aeration is needed mainly during the nighttime hours. In individual impounding sections very different oxygen contents can occur at the same time. Therefore it is necessary to gain information at several points. The staff at the hydropower stations needs information on the amount of aeration water, on the weirs and the hours of overspill 12 to 24 hr in advance. The data is gained through a telemetric system. Automatic data transmission was begun in August 1978. The system works nearly without loss of data. The transmission has been interrupted several times by lightning. (Baker-FRC)
W82-04598

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5F.
W82-04615

PERFORMANCE TESTING OF THE SOVIET OIL/DEBRIS SKIMMER,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-244790, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-154, September, 1981. 4 p, 2 Fig. 68-03-2642.

Descriptors: *Oil skimmers, *Oil spills, *Cleanup operations, Oil recovery, Oil pollution, Viscosity, Harbors, Water pollution control, *USSR.

The oil skimming capability of a specially modified Soviet oil/debris skimmer was investigated at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) in 1979. The self-propelled vessel is 17.7 m long and weighs 39 metric tons. The 111-kw diesel engine drives a ducted propeller, water jet propulsion system. The vessel is capable of 5 knots forward speed and skims effectively at speeds of 0 to 1.0 m/s. The unique combination of various weir designs into one system, vessel mobility, the efficient use of energy, a series-type of oil/water gravity separator, and the propulsion techniques all suggest that this model is an effective harbor skimmer. The oil recover rate of 12.4 cu m/hr was confirmed using high-viscosity test oil in calm water conditions. Recovery efficiency was 85% at 0.77 m/s forward speed, and throughout efficiency was 90% at 0.51 m/s forward speed. Performance dropped when low-viscosity oils were skimmed at faster speeds and higher wave conditions. The skimmer collected 64% of the 81.3 cu m oil volume encountered during the test program. (Moore-SRC)
W82-04621

APPLICATION OF THE AREA OF REVIEW CONCEPT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 6E.
W82-04674

EXPERIENCES WITH FLOATING RESERVOIR COVERS AT THE MANCHESTER WATER WORKS,
Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol 95, No 4, p 258-263, December, 1981. 1 Tab.

Descriptors: *Reservoirs, *Water pollution sources, Reservoir operation, Surface water, Drinking water, Water quality, *Manchester, New Hampshire.

Pollution of open reservoirs by airborne matter, birds and animals and often by man himself has been a problem at the Manchester Water Works for a number of years. A decision was reached in 1969 to install a system of synthetic rubber floating covers over the three open reservoirs as the first phase of a general improvement plan to upgrade and protect water quality. The second phase of the plan involved construction of a complete and modern water filtration system. The Manchester Water System consists of more than 355 miles of mains ranging in diameter from 2 to 36 inches and three principal water distribution reservoirs with a combined storage capacity of 41 MG. The first winter of floating cover operation was a severe test, with a prolonged cold spell of sub-zero weather lasting most of the month of February, resulting in a massive ice buildup along reservoir walls. Several large tears were noted in the cover membrane the following spring. Extensive ice and vandalism caused one of the covers to be removed in 1979. The condition of the remaining two covers is questionable, but the utility estimates a total life expectancy of 10-12 years. During the first year of floating cover operation, bacterial quality of treated water improved substantially, chlorination dosages were lowered, and as a result chemical costs were reduced by about 44%. (Baker-FRC)
W82-04697

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,
New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 6E.
W82-04700

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,
Whitman and Howard, Inc., Wellesley, MA.
J. Murphy.
Journal of the New England Water Works Association, Vol 95, No 4, p 248-252, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, *Water pollution control, *Water supply systems, *Reservoir covers, *New England, Design criteria.

Some of the concepts and problems which must be considered during the design of various covering systems for reservoirs are discussed. One of the earliest steps in the process is to evaluate the problems that the cover is supposed to correct. These may include airborne contaminants, surface runoff, ground-water, vandalism, birds, animals, and aquatic organisms. Open reservoirs which can be evaluated in terms of cost effectiveness of covering are usually among the following: steel reservoirs, concrete reservoirs, and earthen reservoirs. An evaluation of the type of roof system to employ for an open water distribution reservoir must consider such factors as foundation soils, access to the area, location of the facility both from the standpoint of vandalism and topography, climate of the area, dead and live load requirements, the life of various construction materials, the aesthetics of the completed facility, the down-time required for construction, and finally, the relative costs of the various systems. (Baker-FRC)
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,
Globe Linings Inc., Long Beach, CA.
W. B. Kays.
Journal of the New England Water Works Association, Vol 95, No 4, p 253-257, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, Water resources development, Water storage, *Water pollution control, Reservoir covers, *Design criteria, Economic aspects, Water supply.

An attempt was made to develop alternatives to the conventional roof structure for reservoirs. In examining the possibilities of an inflated membrane, the largest drawback appeared to be the high-rise feature. Reservoir owners demanded a flat or nearly-flat profile to ease public relations problems. A compromise was worked out to a 10% rie which owners had to accept if they wished to benefit from the lower costs and other advantages associated with the inflatable roof. The coated fabric that gave the best combination of availability, low cost and high strength was the popular 22/24 oz per sq yd construction, using a 5.5 oz nylon with a 60:40 unbalanced white PVC coating. Disadvantages of this material outweighed the advantages, and a new flexible floating cover system, ROOFLOAT, was designed. The ROOFLOAT cover is essentially a stress-free system. As further developments are made, the following qualifications for a cover should be met: a high degree of outdoor weatherability, with a 50 yr minimum life expectancy in all climates; a relatively simple and effective field and factory seaming procedure that will yield joints that cannot fail; possible field installation at all temperatures above freezing; no delamination of reinforcement fibers or membrane plies; easy repair of the membrane at any age; and physical properties which would allow the aforementioned conditions to be met. (Baker-FRC)
W82-04702

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-04704

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,
RAMLIT Associates, Berkeley, CA.
For primary bibliographic entry see Field 5B.
W82-04393

STOCHASTIC STATE VARIABLE DYNAMIC PROGRAMMING FOR RESERVOIR SYSTEMS ANALYSIS,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and V. T. Chow.
Water Resources Research, Vol 17, No 6, p 1578-1584, December, 1981. 5 fig, 1 Tab, 21 Ref.

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Group 6A—Techniques Of Planning

Descriptors: *Reservoir management, *Operating policies, *Reservoir releases, Reservoir operation, Reservoir storage, *Dynamic programming, Watasheamu Dam, Nevada, Model studies, Stochastic analysis, Markov process, Hydroelectric plants, Electric power production, Systems analysis, Optimization, *Multipurpose reservoirs.

The concept of the state of a system was used to link together state space modeling, dynamic programming, and Markov chain analysis for optimization of reservoir systems in monthly stages over a year. The mathematical description of the inflows to the reservoir system and the response of the system to inflow and releases were formulated as the state space model. This was incorporated within an explicit dynamic programming procedure as the state transition equation. Transition probabilities of the state variables were found for each decision and tested in dynamic programming. Those for the optimal decisions were used in a Markov chain analysis to determine the statistical characteristics of the state and decision variables if the reservoir is operated for a long period with the optimized policy. This method was used to determine the operating policies for the proposed Wastasheamu Dam, Nevada, designed for irrigation water supply, hydroelectric power, and flood control. Operating policies developed by two techniques, independently distributed or serially correlated monthly flows, were similar over the midrange of flows but different for very high and low inflows. chance constraints were used to avoid the probability that storage would be outside the desired range. These constraints may be varied to obtain tradeoffs between economic efficiency benefits and the risk of violating storage limits. (Cassar-FRC)
W82-04430

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,
Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
B. R. Smith.
Energy, Vol 6, No 4, p 323-331, 1981. 3 Fig, 8 Ref.

Descriptors: *Hydroelectric power, *Model studies, *Drought, Long-term planning, Planning, Energy, Electric power production, Linear programming, *Capital costs, Operating costs, Costs, Fuel, *New Zealand.

A linear programming model for long-range planning of electricity generation in areas with a high proportion of hydro power is presented. It considers the effects of both low and high water inflows. Increases in model size are kept to a minimum. This is important in large time-staged models and in multi-fuel supply models. The least cost choice for reserve capacity must account for capital costs of the generating capacity, but also the fuel and operating costs incurred when water intake is low. The model described herein has been implemented in a multi-fuel model of the New Zealand energy system. (Cassar-FRC)
W82-04474

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-04562

A MULTIOBJECTIVE BRANCH AND BOUND METHOD FOR NETWORK-STRUCTURED WATER RESOURCES PLANNING PROBLEMS,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, and J. M. Riley.
Water Resources Research, Vol 17, No 5, p 1349-1359, October, 1981. 4 Fig, 5 Tab, 11 Ref. OWRT A083-KY.

Descriptors: Planning, *Water resources development, Resources development, *Multiobjective planning, Water supply development, Model studies, Computers, Flow, *Network design.

A multiobjective branch and bound method is proposed for analyzing problems involving a network flow structure which are commonly found in the water resources planning field. The method appears to be computationally efficient due to the special problem structure associated with the nonlinear network flow formulation. The method was successfully applied to a realistic regional wastewater planning problem of a moderate size. Also proposed is a multiobjective imputed value analysis which makes use of the branch and bound tree structure and allows comparison of the importance of facilities in the network as represented by individual arcs or sets of arcs. The mathematical formulation and the analysis procedure of the method are described, and the potential usefulness is demonstrated. A Fortran program for implementing the algorithm is available and was used to analyze the example problem consisting of about 650 executable statements. It is an interactive program which provides information on the growth of multiobjective branch and bound trees and the generation of noninferior alternatives in the process of computation. (Baker-FRC)
W82-04563

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,
Texas Univ. at Austin. Dept. of Civil Engineering.
G. Ocanas, and L. W. Mays.
Water Resources Research, Vol 17 No 5, p 1311-1327, October, 1981. 7 fig, 8 Tab, 14 Ref. OWRT 14-34-0001-9483.

Descriptors: *Model studies, *Water reuse, Decision making, Planning, Wastewater treatment, Water treatment facilities, Sinks.

This paper presents a real world application of both the single period and the multiperiod planning models to a region that includes the City of San Antonio, Texas. The use of the single period model is shown through a set of different planning scenarios for the years 1980, 2000, and 2030. The multiperiod model was applied to a planning horizon consisting of three planning periods beginning in the years 1980, 2000, and 2030. The optimal capacity expansion of treatment facilities was determined, considering the capacities already available at the beginning of the planning horizon. The system consists of many elements: water sources, water treatment plants, wastewater treatment plants, and water sinks. The following conclusions were drawn from the study. Optimal water allocation planning should incorporate both water and wastewater systems conjunctively to better assess the impact of water reuse. Economies of scale have a significant effect on the cost and consequently the configuration of the water systems. The solution of a sequence of independent single period problems does not provide an accurate representation of the growing nature of the system. Therefore single-period planning is best suited to assess the impacts of different planning scenarios under current conditions. The performance of the solution algorithm was apparently influenced by the selection of the initial point. The final solution can be dependent upon the specified initial solution, indicating the importance of selecting a good initial point. The model, however, does not provide the ultimate answer to the problem of water allocation and capacity expansion within a region. The model is deterministic; no stochastic or seasonal variations are included. Finally, the model does not guarantee global optimality due to the nonconvex structure of the constraint set and the concavity of the objective function when economies of scale are incorporated. (Baker-FRC)
W82-04565

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,
Ministry of Water and Power, Islamabad (Pakistan).
S. M. H. Bokhari.
Water Supply and Management, Vol 5, No 6, p 377-389, 1981. 22 Ref.

Descriptors: *Water management, *Water policy, *Planning, *Pakistan, Agriculture, Water resources development, Indus Basin, Environmental quality, Economic development, Social aspects, Political aspects, Technology, Water law, Comparison studies, United States.

The history and present state of planning and management of water resources is contrasted for Pakistan and the U.S., two countries with greatly differing economic and social conditions. In the early U.S. planning was almost nonexistent on a federal scale. Water resources were regarded as exploitable for economic development. The battle between conservationists and developers began early in the 20th century and reached a climax during the 1960's. During the 1930's regional and multi-purpose development projects were popular. In 1973 the Water Resource Council adopted two planning objectives, national economic development and environmental quality. Pakistan's history of water resources planning objectives includes the British colonial period 1856-1947, during which the few water projects were greatly underdesigned, wasteful, nonscientific, and without regard to future problems such as waterlogging and salinity of the soil. Investments were minimized. A Development Board was created a year after Independence to prepare a 5-year plan. These plans have been prepared regularly since 1955. Objectives for water resources development included conservation, development of new surface and groundwater resources, increasing irrigated areas, reclamation of waterlogged and saline soils, flood and erosion control, and a research program. Project evaluation in Pakistan is based on benefit-cost analysis. The many differences in background and policy between the two countries make it impossible to effectively apply planning objectives from the U.S. in the developing countries. (Cassar-FRC)
W82-04605

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
A. W. Burns.
Geological Survey Water-Resources Investigations 80-119, 1981. 61 p, 24 Fig, 11 Tab, 9 Ref.

Descriptors: *Model studies, *Preimpoundment, *Water table, *Surface-groundwater relations, Simulation analysis, Forecasting, Reservoirs, Dams, *Colorado, Morgan County, Narrows Reservoir, *South Platte River, Groundwater movement.

A computer model, including a ground-water-flow component and a mass balance reservoir-operations component, was developed to simulate the proposed Narrows Reservoir and the adjacent alluvial aquifer of the South Platte River, Morgan County, Colo. This model, using a weekly time step, simulated the transient interactions of these two systems for an initial-fill condition and general-operational condition. A sensitivity analysis was made to test the effects of possible errors in the description of aquifer characteristics on the model results. The initial-fill simulation indicated that to fill the reservoir when hydraulic connection between the surface-water system and the aquifer is simulated would take 2 additional years than if no connection was assumed. Simulated ground-water return flow to the river downstream of the proposed dam was about 85 percent of the estimated maximum values, computed under steady-state conditions in an earlier study. The general operation simulation indicated that during the period of lowest reservoir contents the aquifer provided about 80,000 acre-feet of recoverable storage to the reservoir's capacity. Average return flow was only about 70 percent of the estimated maximum values computed in the earlier, steady-state analysis. Monthly ground-water outflow from the reservoir to the aquifer ranged from 55,200 to -10,400 acre-feet. Parameters tested for sensitivity, in order of decreasing sensitivity, were: Hydraulic conductivity, specific yield, hydraulic connection between

reservoir and aquifer, local recharge, boundary conditions, and dam permeability. The probable error in the parameters tested would not seem to warrant significant new data collection. (USGS)
W82-04725

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,
Systems, Science and Software, LaJolla, CA.
J. W. Pritchett, and S. K. Garg.
Water Resources Research, Vol 16, No 4, p 665-674, August, 1980. 7 Fig, 6 Tab, 6 Ref.

Descriptors: *Wells, *Reservoirs, *Simulation, *Numerical analysis, Mathematical equations, Model studies, Underground reservoirs, *Groundwater movement.

When using a numerical simulator to model underground reservoir behavior, it is often necessary to use well blocks, which are grid blocks containing a well, with dimensions much larger than the well diameter. Practical procedures have been developed for making reasonable estimates of well bore sandface conditions from the well block conditions calculated by numerical reservoir simulations. Assuming that pressures will equilibrate much more rapidly on a subgrid scale than in the reservoir as a whole, the subgrid flow may be treated as steady flow. The conditions at the sandface may then be deduced from mean well block conditions by assuming that the latter obtain at a definite distance, defined as the 'effective well block radius', from the well. However, the value of this effective well block radius must be established in terms of the size of the well block and other relevant parameters. Examination of the grid pressures obtained in the numerical solution of liquid flow into a single well located in both radial and rectangular grid blocks showed that the effective well block radius depends on the shape of the grid block (radial or rectangular), the type of mesh (uniform or otherwise), and the character of the spatial discretization scheme, among others. (Carroll-FRC)
W82-04732

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,
Science and Education Administration, Lincoln, NE.
R. T. Clark.
Water Resources Bulletin, Vol 16, No 1, p 36-40, February, 1980. 9 Ref.

Descriptors: *Water resources development, *Cost-benefit analysis, Regional development, Resources development, Urban planning, Planning, *Input-output analysis.

The purpose of this research was to aid the use of input-output (I-O) in conjunction with benefit-cost (B-C) analysis for water resource development type projects. Terminological differences and differences due to benefit measuring methods are discussed. Proper use of the I-O model for estimating the secondary methods are discussed. Proper use of the I-O model for estimating the secondary effects depends in part on how the project benefits were valued, whether project outputs were sold to final or intermediate demand, and whether project output is represented by an endogenous sector. The analyst must look to the total effects on household income to determine secondary effects for B-C. Consequently, I-O models closed to households are more helpful than those that are open. Access to only final demand multipliers will limit the usefulness of I-O for estimating secondary benefits and costs, since final demand multipliers measure gross output changes instead of household income changes. Even income multipliers are not as helpful as the entire I-O model. There are many issues related to proper use of the I-O model that depend on the analyst's knowledge of I-O techniques and knowledge of how a specific model was developed. A result is that even though I-O can be helpful it can also be rather easily misused and can, therefore, provide misleading information. (Baker-FRC)
W82-04733

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,
North Carolina Water Resources Research Inst., Raleigh.
N. S. Grigg, and H. A. Vance.
Water Resources Bulletin, Vol 16, No 1, p 69-71, February, 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Urban drainage, *Planning, *Economic aspects, *Flood control, Public opinion.

A new method is presented for determining the demand for urban drainage and flood control projects and to show how it can be used as part of an integrated planning procedure for setting priorities and allocating funds to competing projects. The method was devised by the Los Angeles County Flood Control District. The basic objective of the plan is to develop a logical rational planning procedure that will consider public demand for projects and allow planning to take place in the open. This ensures that opposition will be identified and dealt with early in the planning process and that surprises will be minimized. Results should yield a better utilization of the public funds both for planning and for implementation. The BENEVAL equation as developed represents a major step, as it is a surrogate measure of the public perception of the value of projects. It allows both screening for projects whose further development should be considered based on economic justification and prioritizing to allow greatest attention to those projects which are most urgent. (Baker-FRC)
W82-04737

6B. Evaluation Process

AUBURN DAM: A CASE STUDY OF WATER POLICY AND ECONOMICS,
Montana Univ., Missoula. Dept. of Economics.
J. W. Duffield.
Water Resources Bulletin, Vol 16, No 2, p 226-234, April, 1980. 4 Tab, 39 Ref.

Descriptors: *Cost-benefit analysis, *Water policy, *Economic analysis, Benefits, *Dams, *Auburn Dam, American River, *Sacramento, California, Water resources development, Earthquakes, Recreation, Irrigation, Dam failure.

This paper critically analyzes the economic justification of the Auburn Dam, part of the $1.5 billion Auburn-Folsom south unit of the Bureau of Reclamation's Central Valley Project in California. Construction on this dam has been stopped because the high thin arch structure, located on a major geological fault, is being recesigned for greater earthquake resistance. Errors in previous benefit-cost estimates were large. Irrigation benefits were overestimated and recreational losses underestimated. Revised benefit-cost ratios are 0.61 at 3 and 1/8% discount rate and 0.18 at 6 and 5/8% discount rate. Original estimates were 1.72 and 0.79 at the respective discount rates and failed to consider the cost of the permanent inundation of 48 miles of the American River Canyon or a probability-weighted estimate of catastrophic earthquake loss (much of metropolitan Sacramento would be inundated). This paper recommends that the project should not be continued. Suggestions for improving benefit estimation are: (1) use several approaches, (2) give priority to direct evidence of willingness to pay, as in market prices, (3) perform a site-specific analysis if results are sensitive to changes in average national numbers parameters, and (4) do not ignore destruction of natural environments such as wild rivers. (Cassar-FRC)
W82-04260

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
D. C. Cory, and J. Daubert.
Water Resources Bulletin, Vol 17, No 6, p 1066-1070, December, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Benefits, *Cost-benefit analysis, *Irrigation programs, Agriculture, Corn, *Nebraska, Economic analysis, Error analysis, Irrigation efficiency.

Commonly used methods for estimating direct benefits from irrigation are compared with a new method which estimates the sum of the changes in producers' and consumers' surplus. Errors inherent in the traditional methods are computed. Traditional methods measure impacts on the commodity markets by assuming the supply is inelastic. They either assume no change in commodity prices and calculate net returns to project farmers or allow commodity prices to fall in accordance with a given elasticity of demand and subtract commodity production costs from the associated area under the commodity demand curve. The new approach is used to evaluate 3 similar irrigation projects in Nebraska. Errors in benefits were 2% for the smallest project (10,000 acres of corn), and 8% and 15% for the larger projects (44,000 and 77,000 acres), respectively. (Cassar-FRC)
W82-04287

ENVIRONMENTAL THRESHOLD FUNCTIONS FOR USER ORIENTED RESOURCE PLANNING AND MANAGEMENT,
Illinois Univ. at Chicago Circle. School of Urban Sciences.
J. S. DeBettencourt, and G. L. Peterson.
Water Resources Bulletin, Vol 17, No 6, p 1050-1055, December, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Management planning, *Recreation, *Evaluation, Planning, Rivers, Surveys, Model studies, *Recreation facilities, *Site selection.

A method for assessing and measuring recreational site quality, called environmental threshold modeling, is described. It is based on the idea that persons using the recreation facilities have specific identifiable criteria which can be expressed as a mathematical function of site characteristics. The function separates acceptable recreational settings from unacceptable settings, hence the term, threshold function. The individual specific threshold functions can be combined to produce a population specific threshold function that gives the proportion of the population that finds a particular setting acceptable for a specific activity. Canoeists using the Pine River in Michigan's Manistee National Forest were asked to state whether or not each of 15 randomly generated combinations of characteristics would be acceptable for recreational canoeing. The characteristics were four levels each of water condition (pure to undesirable), degree of development (wilderness to urban), crowding/use (no other users to large number of users), trash/litter (none to heavy), and skill level required for canoeing (expert to beginner). The equation predicted that 80% of those surveyed would find characteristics of the Pine River site acceptable for use. If littering and crowding were reduced, the proportion of the population finding the conditions acceptable would rise to 93%. (Cassar-FRC)
W82-04289

FLOOD PROBABILITY ESTIMATION,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
S. O. Russel.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 63-73, January, 1982. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Flood forecasting, *Design floods, *Estimating, Hydrologic data, Flood data, Flood frequency, Susquehanna River, Carpenter Creek, British Columbia, Streamflow, Flood peak, Numerical analysis, Computer programs.

A procedure is presented for estimating design floods from the many types of hydrologic information available, even though there is not sufficient data for conventional frequency analysis. A compound distribution is used, and parameters of the underlying distribution are updated using Bayes' theorem. This permits subjective information to be combined with recorded data. The subjective information, not generally usable for traditional frequency analysis, may include a few recorded

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floods, memory of bridges not being overtopped, evidence of a very large flood, envelope curves for the area, and river cross-sections. Numerical methods are used because analytical procedures are too limited. A computer program is used for calculations. Examples are given for a hypothetical case and for Carpenter Creek, British Columbia, and the Susquehanna River. The sparser and more uncertain the available data, the more conservative the results. (Cassar-FRC)
W82-04318

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,
Hydro Watts Inc., Washington Grove, MD.
For primary bibliographic entry see Field 8A.
W82-04327

REGULATING CORROSIVE WATER,
Environmental Protection Agency, Washington, DC.
R. Anderson, and D. Berry.
Water Resources Research, Vol 17, No 6, p 1571-1577, December, 1981. 5 Tab, 22 Ref.

Descriptors: *Cost-benefit analysis, *Corrosion control, *Public health, *Water treatment, Benefits, Drinking water, Regulations, Lead, Toxicity, Cadmium, Asbestos, Water softening, Diseases, Lime, Economic analysis.

The benefit-cost relationships of an EPA proposal to regulate the corrosvity of drinking water are examined. Corrosivity may result from low pH, low buffering capacity, presence of dissolved oxygen, high total dissolved solids, high halogen and sulfate/alkalinity ratio, and high temperature. The major health effects of corrosive water are lead toxicity, increased incidence of hypertension and cardiovascular disease produced by cadmium, and the possibility of cancer from ingestion of asbestos fibers. Possible benefits of reducing corrosivity are less health risk, fewer operations and maintenance problems, and improved esthetics (reduction of discolored water and stained fixtures). Negative effects of increasing the water hardness to reduce corrosivity are negligible. Evidence indicates that water treatment to reduce corrosivity is warranted, especially for larger systems. Costs per life saved vary from $1720 (145 lives saved per year) in a 100 mgd plant serving 1 million people to $114,000 (0.0036 lives saved per year) in a 2500 gpd plant serving 2500 people. Annual per capita costs for lime treatment of soft water range from 25 cents for the 100 mgd plant to $16.40 for the 2500 gpd plant. This study illustrates the uncertainties involved in placing an economic value on benefits from reduction in incidence of diseases. (Cassar-FRC)
W82-04335

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,
California Univ., Davis.
For primary bibliographic entry see Field 3F.
W82-04360

GRANULAR ACTIVATED CARBON INSTALLATIONS,
Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 5F.
W82-04391

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,
Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
For primary bibliographic entry see Field 6A.
W82-04474

DEVELOPMENT OF HYDRO-POWER IN NIGERIA,
Benin Univ. (Nigeria). Dept. of Physics.
V. C. Sharma, and A. Sharma.
Energy, Vol 6, No 6, p 475-478, 1981. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Hydroelectric power, Prediction, *Nigeria, *Developing countries, *Costs, Water demand, Water use, Interest rates, Project benefits, Energy conservation.

Nigeria has a hydropower potential of 9500 MW, including 1300 MW from 21 minor sites. Only 8% of this or 800 MW has been developed. Early development of hydropower will not only reduce the burden on Nigeria's crude oil supply, but will also have an impact on agriculture, fish industry, fresh water supply, navigation and employment. The rate of hydropower development is heavily dependent on international loans from industrialized nations. Total hydropower generating capacities in 1985 and 1995 are expected to be 3245 and 4895 MW, respectively, reaching 8185 MW by 2000. (Cassar-FRC)
W82-04475

REVERSING WATER POLLUTION STANDARDS IN AN UNCERTAIN WORLD,
Geological Survey, Reston, VA.
W. D. Watson, and R. G. Ridker.
Land Economics, Vol 57, No 4, p 485-506, November, 1981. 4 Fig, 6 Tab, 14 Ref.

Descriptors: *Decision making, *Water pollution control, *Water quality standards, Planning, Nonpoint pollution sources, Water pollution sources, Regulations, Legal aspects, *Cost-benefit analysis, Benefits.

The overall results of a decision analysis of EPA's water pollution control policies indicate that lower costs for implementing these controls would be incurred if significant amounts of additional information were gathered and decisions changed accordingly. Little concrete information is available concerning the contribution of nonpoint pollution sources to water quality degradation. There is a possibility that more pollution control at lesser cost could be attained by reducing nonpoint source pollution than by upgrading point source treatment systems. Two cases were assumed: (1) EPA is attempting to minimize expected costs and (2) EPA is establishing controls to achieve fishable and swimmable water quality. The expected cost savings provided by additional information are $400 million per year at present, rising to $2 billion per year in Case (1) and $1 billion per year in Case (2) by 2010. These estimates are considered conservative. (Cassar-FRC)
W82-04540

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,
J. Donnan.
Water and Pollution Control, Vol 119, No 11, p 9-10, 12, 1981.

Descriptors: *Benefits, *Environmental quality, *Industrial wastes, Economic aspects, *Water pollution control, Water pollution prevention, Cost-benefit analysis, Social aspects, Regulations, Environmental policy, Public health, *Canada, Waste treatment.

Pollution control efforts must be directed toward the opportunities and benefits that can be attained. Economic studies have indicated that pollution control expenditures by industry are small relative to other expenditure categories and investments. The adverse effects on inflation and economic growth are insignificant. It has been more effective to apply pollution control technologies and waste prevention early in an industrial process than to treat waste products at the end. The 3M company has saved $17.4 million in this way over 3 years. For example, in one installation ppainting equipment designed to avoid overspraying cost $45,000 and saved the plant $120,000 per year in resin and paint costs. Tightening flanges at a Union Carbide plant saved $2,000 per day in raw material costs. Other possibilities for combined pollution and cost reduction are avoiding spills, reclaiming materials (such as wood fibers in paper mills), running a clean and tidy operation, using low sulfur fuels, changing a process to a less polluting one (producing chlorine for pulp bleaching by a mercury free process), producing saleable products from waste materials (suluric acid from SO2), and early environmental assessments in the planning or new plant construction. The public benefits of pollution control include reductions in pollution damage and increased enjoyment of a cleaner environment. Pollution costs are borne by a small, easily identifiable segment of society; benefits are spread over a large, less easily identifiable group. (Cassar-FRC)
W82-04554

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,
For primary bibliographic entry see Field 5D.
W82-04597

CLEAN WATER FOR THE THIRD WORLD,
Biswas and Associates, Oxford (England).
For primary bibliographic entry see Field 6D.
W82-04604

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH--LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,
Water and Sanitation for Health Project, Washington, DC.
For primary bibliographic entry see Field 6D.
W82-04606

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.
Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-44, Price codes: A06 in paper copy, A01 in microfiche. Department of Energy DOE/CE/04934-44, March, 1981. 106 p, 17 Tab, 1 Append. AS02-78RA04934.

Descriptors: *Hydroelectric plants, *Financing, *Economic feasibility, *Loans, Government finance, Costs, Marketing, Economic aspects, Regulations.

As a result of legislative and regulatory improvements, small scale hydroelectric (SSH) development is viewed as a potentially profitable enterprise. However, the lack of recent models for the development of SSH projects causes problems in the financing of these projects. A lack of developer information and a lack of lender information can combine to make it difficult to obtain funds necessary for the development of projects characterized by relatively large fixed costs, and whose only underlying security is the value of the power output. This manual is a description of the financing process associated with the private development of SSH projects, and is intended to provide the developer with some assistance in meeting the challenge of deciding how to proceed with the critical task of arranging the financing of his project. In any business venture, the business plan is a crucial guide for both internal and external financing decisions. The financing of SSH projects differs from most small business loans in that a SSH project usually requires an exceptionally large ratio of debt to equity, has an unusual marketing structure and is exposed to a pervasive regulatory scheme. A business plan should address the variables affecting the size, structure and cash flow and show how they would affect the project. The three business forms considered are corporations, Subchapter S corporations, and partnerships. Sources of funds which should be considered: commercial banks and savings and loan associations; manufacturers of hydroelectric equipment; investment bankers; state and municipal industrial development authorities; and federal financing assistance. (Moore-SRC)
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.
Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.

For primary bibliographic entry see Field 6E.
W82-04634

ENERGY TECHNOLOGY SCENARIOS FOR USE IN WATER RESOURCES ASSESSMENTS UNDER SECTION 13A OF THE FEDERAL NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT.
Department of Energy, Washington, DC. Office of Environmental Assessments.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0090, Price codes: A09 in paper copy, A01 in microfiche. DOE/EV-0090, October, 1980. 185 p, 6 Fig, 7 Tab, 17 Ref, 6 Append.

Descriptors: *Energy, *Fuel, *Water resources development, *Prices, *Hydroelectric power, *Geothermal power, Economic aspects, Forecasting, Future planning, Economic aspects, Pumped storage, Resources development, River basin development, Technology.

Two estimates of future growth of emerging energy technology in the years 1985, 1990, and 2000 were developed to be used as a basis for conducting Water Resources Council assessments. The two scenarios are called the high world oil price (HWOP) and low world oil price (LWOP) cases. The scenarios were generally derived from assumptions of he Second National Energy Plan (NEP II), including estimates of high and low world oil price cases growth rate of GNP, and related economic parameters. The overall national energy growth inherent in these assumptions was expressed as a detailed projection of various energy fuel cycles through use of the Fossil-2 model and regionalized through use of the strategic Environmental Assessment System (SEAS). These scenarios are for the use of regional analysis in examining the availability of water for and the potential impacts of future growth of emerging energy technology in selected river basins. The energy scenarios provide projections for the following categories of emerging energy technology: coal gasification; coal liquefaction; oil shale; geothermal; enhanced oil recovery; solar and biomass; small scale, low head, and pumped storage hydroelectric; and advanced coal combustion. (Moore-SRC)
W82-04635

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,
Tudor Engineering Co., San Francisco, CA.
D. C. Willer.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 209-217, December, 1981. 4 Fig, 4 Tab, 3 Ref.

Descriptors: *Hydroelectric plants, *Cost-benefit analysis, *Feasibility studies, Hydraulic structures, Benefits, Dams, Powerplants, Energy, Economic analysis, Capital costs, Rate of return, Discount rates, Small-scale hydropower.

Techniques for evaluating the economic feasibility of small hydropower projects are presented and illustrated with examples. The simplest is the benefit-cost analysis, which compares annualized capital, operating, maintenance, and administration costs with the value of power produced. Another method is that using the internal rate of return, the discount rate where the benefit-cost ratio equals 1.0. It is computed by plotting several benefit-cost ratios vs. discount rates. A third technique is the discount cash flow analysis, which uses different escalation and discount rates to provide a variety of benefit-cost streams. The present worths of the benefit-cost streams are then assumed and a ratio computed. A further consideration is the primary energy factor, the energy required to manufacture and construct a hydro project. (Cassar-FRC)
W82-04693

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,
Science and Education Administration, Lincoln, NE.
For primary bibliographic entry see Field 6A.
W82-04733

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,
Western Washington Univ., Bellingham. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W82-04740

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER QUALITY ALLOCATED COST FOR MULTIPURPOSE RESERVOIRS,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Water Resources Bulletin, Vol 16, No 1, p 127-132, February, 1980. 7 Tab, 5 Ref.

Descriptors: *Water quality, *Cost allocation, Reservoirs, Cost sharing, Economic aspects, Cost analysis, Low flow, Water management, Wastewater treatment, Flow augmentation, *Multipurpose reservoirs, *Model studies, *Willamette River, Oregon.

Apportionment of reservoir costs may be appropriate to downstream waste water dischargers who by virtue of reservoir drawdown may be saved the expense of advanced secondary of tertiary waste treatment. Low flow augmentation from multipurpose reservoirs may yield significant water quality benefits. By using cost allocation, a portion of reservoir expense is assigned to water quality consumers, waste water dischargers who benefit from the increased receiving flow. Federal projects do not authorize such allocation. However, the procedure is increasingly appropriate for efficient multiobjective management. A model was constructed for waste water treatment costs, multipurpose reservoir costs, and water quality for Oregon's Willamette River. Water quality is expressed as a function of treatment and augmentation levels. Treatment cost needed to achieve a given quality of water without augmentation less treatment cost with augmentation gives an alternative cost of maintaining water quality. This alternative cost is used to determine water quality's share of reservoir cost via a cost allocation procedure. Water quality beneficiaries could be charged, under current conditions, about 7% of annualized reservoir expense. This charge is one-fourth of the expense of additional treatment facilities required if augmentation were not provided. (Baker-FRC)
W82-04255

CONSERVING WATER THROUGH PRICING,
State Univ. of New York at Albany.
For primary bibliographic entry see Field 3D.
W82-04272

MARGINAL COST AND SEASONAL PRICING OF WATER SERVICE,
West Virginia Univ., Morgantown. Regional Research Inst.
P. C. Mann, and D. L. Schlenger.
Journal of the American Water Works Association, Vol 74, No 1, p 6-11, January, 1981. 7 Ref.

Descriptors: *Water rates, *Marginal costs, *Seasonal variation, Pricing, Costs, Water demand.

Seasonal pricing is not synonymous with marginal cost pricing, although it is a logical consequence of the latter. Effective seasonal pricing requires that several criteria be fulfilled. There must be substantial variations in demand between peak and off-peak periods. Installed capacity requirement must be determined primarily by the peak demands of the specific system. The water utility must have peak demands which consistently occur during the same periods of the year, and the water utility must be able to estimate the difference in cost between meeting peak and off-peak demands. Several application problems can impede the use of seasonal pricing: cost calculation problems, prediction problems, excess revenue problems, income distribution and efficiency problems, needle peaking, shifting peaks, public acceptance, and metering difficulties. Systematic consideration of these problems is necessary for successful implementation of innovative pricing plans. They should not be regarded as barriers to reform in rate structures. (Carroll-FRC)
W82-04273

ON THE MARGINAL COST OF WASTEWATER SERVICES,
President's Council of Economic Advisers, Washington, DC.
S. H. Hanke, and R. W. Wentworth.
Land Economics, Vol 57, No 4, p 558-567, November, 1981. 3 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Pricing, *Marginal costs, Economic aspects, *Operating costs, Capital costs, Cost analysis, Economies of scale, Opportunity costs, Tariff.

The marginal cost of municipal wastewater services is analyzed for the purposes of designing a tariff for these services. In this paper marginal cost of wastwater services is defined so that the opportunity cost may be measured. The marginal cost is estimated for a hypothetical wastewater system, capacity 570,000 cu m per day, using the activated sludge process to serve a community of 300,000. In 1979 the total marginal cost for this system was 57 cents per cu m per year (54 cents major capital costs and 3 cents running costs). A two-part tariff is the most efficient and sound. Part 1 is the price per composite unit of use (57 cents in the above example) and part 2, the annual standing charge per customer (equal to the total cost of system overheads not directly related to use, but necessary to guarantee system maintenance over time). The overheads may include costs of meters, billing expenses, and connection costs. (Cassar-FRC)
W82-04376

COSTING DAR-ES-SALAAM'S SANITATION PLAN,
Peat, Marwick and Co., London (England).
M. Hoyle, and R. Eadie.
World Water, Vol 4, No 12, p 30-31, December, 1981.

Descriptors: *Waste disposal, *Domestic wastes, *Urban areas, *Costs, Sewer systems, Sanitation, Public health, Housing, *Tanzania, Urban hydrology, Land disposal, *Developing countries.

Since two-thirds of the householders of Dar-esSalaam, Tanzania have low incomes and are unable to pay for high-priced sanitation systems, a new master-plan for low cost sewage disposal was drawn up from data on water consumption, plumbing facilities and income levels to accomodate the new housing developments with sanitary sewage disposal systems. The first stage of the plan, which will take from 1981-85 to complete, calls for the installation of improved pit latrines in most housing units, the implementation of a community health education program, and a rehabilitation and expansion of the pit emptying service. Funds for this stage will come from City Council, the World Bank, and other government aid agencies. Direct educational assistance will be given to households needing to install new latrines, while the cost of constructing and emptying the pit latrine will be borne directly by the owner of the house. The total cost for construction and maintenance of the pit latrine should account for no more than about 1.5% of total family income. The extension of the pit installation service should be funded out of general taxation because the annual user per capita costs are small and the direct beneficiaries of such a service are not identifiable. An Urban House Tax based upon the type of latrine present would be charged as a simple flat rate to each household. At present, pit emptying is carried out by the City Council and a number of independent operators who receive full payment when services are rendered or collect payments over the course of set periods by a more easily payable installment plan. (Geiger-FRC)
W82-04603

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Group 6C—Cost Allocation, Cost Sharing, Pricing/Repayment

FINANCING FEDERAL WATER DEVELOPMENT PROJECTS AND SHARING THE COSTS,
Water Resources Council, Washington, DC.
R. M. Wheeler, L. M. Eisel, and G. D. Seinwill.
Water Resources Bulletin, Vol 16, No 2, p 326-335, April, 1980. 5 Fig, 20 Ref.

Descriptors: *Financing, *Water supply development, *Cost sharing, Water management, Planning, Administration, Political aspects, *Federal jurisdiction, Economic aspects.

A brief survey is presented of past and present Federal involvement in water resources development, along with a closer look at the nature of cost sharing and an assessment of the varied assortment of existing Federal and non-Federal cost sharing provisions. Samplings of some relevant emerging issues are presented, with the focus on policy questions that are currently arising due to competing interests for water and water project funding. Several proposed strategies for dealing with cost sharing policy reform are discussed, with detailed emphasis on two current proposals under consideration. The joint venture approach results in an effective composite cost share which changes significantly but not drastically, from 19 to 35% non-Federal share for a hypothetical project. The block grant approach would alter the regional distribution of Federal water development funding from the South and West to the Northwest and North Central States. To be successful any strategy not only must be theoretically sound, but must be politically sound as well. Practical solutions must be sought through the existing political structure, as any realistic solution generally requires the transfer of a subsidy from one interest to another. (Baker-FRC)
W82-04739

THIRD-DEGREE PRICE DISCRIMINATION AND REGULATION IN THE MUNICIPAL WATER INDUSTRY,
Lafayette Coll., Easton, PA.
T. H. Bruggink.
Land Economics, Vol 58, No 1, p 86-95, February, 1982. 5 Tab, 17 Ref.

Descriptors: *Pricing, *Water rates, Regulations, Economic aspects, Water demand, Water supply, *Price discrimination.

This paper discusses the practice of third-degree price discrimination and the role of state regulation in governing rate structures as they concern the structuring of rates for municipally owned water utilities. The conclusions suggest that third-degree price discrimination is practiced by municipally owned water utilities. The average pice-marginal cost ratios for the residential, commercial, and industrial customer classes are 3.45, 2.32, and 1.52, respectively in the unregulated utilities, and 3.12, 1.81, and 1.04 in the regulated utilities. The differences are excessively large, with the industrial customers clearly identified as the benefited group. There is no evidence of internal subsidization across the customer classes. However, the excessive price discrimination is undesirable under the criteria suggested by Hollas and Friedland. Also noted are sharp reductions in the price-cost ratios for all customer classes in utilities regulated at the state level. The reductions are uneven, however, with the industrial and commercial customer classes receiving larger absolute and percentage reductions than the residential class. In regulated, municipally owned electric utilities the industrial customers had the lowest price-cost ratios. (Baker-FRC)
W82-04747

6D. Water Demand

DETERMINISTIC MODELS FOR PREDICTING RESIDENTIAL WATER CONSUMPTION,
Department of Transport and Works, Darwin (Australia).
N. A. Power, R. E. Volker, and K. P. Stark.
Water Resources Bulletin, Vol 17, No 6, p 1042-1049, December, 1981. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Water consumption, *Lawns, *Domestic water, *Model studies, Water demand, *Residential water, *Water use, Irrigation, Townsville, Australia.

Two deterministic models for forecasting residential water demand are presented. Lawn water requirements and in-house use are considered separately, then combined for a total predicted consumption. The in-house model requires the residence population, appliance ownership per residence, and water consumption of an appliance per use. It can simulate effects of changes in appliance ownership patterns, population distribution, appliance unit water use, and frequency of use. The lawn water model is a daily water balance model with a single soil moisture store. It operates in two phases, a drying phase through evaporation and transpiration and a wetting phase through rainfall and irrigation. Residential water consumption in Townsville, Australia, was modeled after a survey of a random sample of residences. In-house model results were 197 liters per capita per day; 205 liters per capita per day was obtained by measuring sewage flows. Simulations showed that increases of 100% in dishwasher ownership and garbage disposal ownership would increase average in-house consumption by 5.2% and 3.4%, respectively. Lawn water consumption was measured at five metered homes for 12 months. Simulated and actual water applied agreed within about 6 mm in the range of 669-885 mm seasonal irrigation water depths. (Cassar-FRC)
W82-04352

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
For primary bibliographic entry see Field 6E.
W82-04441

AN ECONOMIST'S VIEW OF DEMAND PROJECTIONS CONSIDERING CONSERVATION,
California Univ., Santa Barbara. Dept. of Economics.
W. D. Morgan.
Water Resources Bulletin, Vol 16, No 5, p 941-943, October, 1980. 2 Fig, 6 Ref.

Descriptors: *Water demand, *Water conservation, *Water use, *Economic aspects, Prices, Water management, Water supply, Mathematical studies, Elasticity of demand.

An approach was developed to clarify and elaborate on procedures for measuring water use undder alternative conservation specifications. An attempt was made to place the analyses in terms of traditional economic analysis. Using this analysis, the effects of conservation can be divided into two classes, pure conservation effects and pure demand management. The use of demand management to reduce quantity demanded operates through an increase in the price of water, which means individuals move up their demand curve and choose a smaller quantity. Conservation policies incorporate other factors that affect water usage, while holding the price constant. An increase in the conservation percentage reduces the quantity of water demanded. Providing information on techniques or technology is very important to enable users to choose the proper amount of water needed to meet their specified goals. Some instruments to meet these goals are under the control of the water agency, while others are not. However, the variable price is always under the control of the water purveyors. (Baker-FRC)
W82-04448

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. M. Cordova.
Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 70, 1981. 87 p, 18 Fig, 3 Plates, 23 Tab, 30 Ref.

Descriptors: *Groundwater, *Aquifer characteristics, *Water quality, *Well yield, Well data, Pumping, Drawdown, Groundwater recharge, Water level fluctuations, Surface-groundwater relations, Groundwater availability, Water supply, Water demand, Chemical analysis, Maps, *Utah, Virgin River basin, Kanab River basin, Navajo Sandstone.

The upper Virgin River and Kanab Creek basins area in south-central Utah includes about 1,300 square miles in the upper Virgin River basin and about 650 square miles in the upper Kanab Creek basin. The sparsely populated area contains large coal reserves. Water occurs in both the unconsolidated and consolidated rocks. Principal aquifers in the unconsolidated rocks include older stream-channel deposits, lower parts of alluvial fans, and stream-valley alluvium. The most important consolidated-rock aquifer is the Navajo Sandstone of Triassic and Jurassic age. Other consolidated-rock aquifers of note include the Shinarump Member of the Chinle Formation of Triassic age, sandstone strata of Cretaceous age, and the Wasatch Formation of Tertiary age. Groundwater recharge is derived chiefly from precipitation on the area and is estimated to average about 80,000 acre-feet per year. Discharge occurs chiefly as seepage to lower stream reaches and evapotranspiration; natural discharge is estimated to total at least 62,700 acre-feet per year. In addition, about 5,000 acre-feet per year discharges as underflow into Arizona; and in 1977, at least 3,300 acre-feet was withdrawn by wells. Chemical quality of ground water varies considerably with geologic source. Water in the Navajo Sandstone and Wasatch Formation is generally fresh, containing less than 500 mg/L of dissolved solids in most places. Water in the Chinle and Moenkopi Formations of Triassic age and the Carmel Formation of Jurassic age is generally saline, containing 1,000 to 3,000 mg/L of dissolved solids in most places. (USGS)
W82-04486

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04513

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W82-04514

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04518

CLEAN WATER FOR THE THIRD WORLD,
Biswas and Associates, Oxford (England).
A. K. Biswas.
Water Supply and Management, Vol 5, No 6, p 401-415, 1981. 12 Ref.

Descriptors: *Drinking water, *Public health, *Developing countries, United Nations, *Costs, International Drinking Water Supply and Sanitation Decade, Water resources development, Sanitation, World Health Organization, Education, Water supply, Water quality standards, Investment, Institutional constraints, Political constraints, Reviews.

Current information on the availability and use of potable water in developing countries is critically

reviewed. Weaknesses in the World Health surveys of 1962, 1970, and 1975 are incomplete information (China and several other countries were not included), countries overestimating or underestimating the status of clean water supplies either to improve their images or to call attention to their difficulties, the intermittent nature of water service in may locations, and differences in enumeration method among countries. Provision of clean water without concurrent improvements in sanitation and health education is very ineffective. Western world water quality standards cannot be imposed on developing countries because significant percentages of existing water suplies would be automatically condemned and cost of equipment and personnel to maintain these high standards would be impractically high. The goal should be a variable standard to suit the locale, people, infection risks, and finances. Many cost estimates for the Decade have been calculated and revised. The currently accepted cost is $300 billion, considered by many to be a serious underestimate. There is small chance that the Decade will meet its goals. Constraints that must be overcome to ensure success are the lack of funds in the developing countries, the priorities of the individual countries, the lack of institutional infrastructure in many areas, lack of trained manpower, and lack of understanding of local conditions. (Cassar-FRC)
W82-04604

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,
Ministry of Water and Power, Islamabad (Pakistan).
For primary bibliographic entry see Field 6A.
W82-04605

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH--LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,
Water and Sanitation for Health Project, Washington, DC.
R. B. Isely.
Water Supply and Management, Vol 5, No 6, p 417-424, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Drinking water, *Public health, *Social aspects, Sanitation, International Drinking Water and Sanitation Decade, Benefits, *Developing countries, United Nations, Diseases, Women, Children.

The chief beneficiaries of planned improvements in developing countries' water supplies and sanitation will be women and children. The average East African woman uses 9% of her daily caloric intake to obtain water for the household, up to 27% in hilly country. Diarrhea and its effects account for 30% of deaths in Third World children 0 to 4 years old. Waterborne diseases are responsible for undernutrition and many other ailments. Benefits from safe water supplies and improved sanitation are three fold: a better quality of life for women, reduced mortality and morbidity in young children, and the advantages that mother and child experience as a single bio-social unit (increased birthweight of infants, prolonged breastfeeding period, more time for child care, and a reduction in birth rate). (Cassar-FRC)
W82-04606

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: SEVIER LAKE BASIN, UTAH.
Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Appraisal Report, September, 1980. 61 p, 20 Fig, 10 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Water demand, *River basin development, Irrigation, Flood control, Precipitation, Runoff, *Sevier Lake basin, *Utah.

The Sevier Lake basin is a major land-locked drainage basin covering all or portions of 11 counties in southwest Utah and a small portion of one county in Nevada. Average annual precipitation ranges from about 8 inches in the western desert to over 30 inches in the mountains. In spite of groundwater tables, which tend to recharge the Sevier River, losses to evapotranspiration aided by irrigation deplete flows in the river to the extent that runoff reaches Sevier Lake only during rare high flows. Approximately 400,000 acres (less than 5% of the total basin area) are irrigated. Fourteen small operating hydroelectric powerplants in the basin have a combined installed capacity of 6,260 kw, of which 77% is under license. The basin's hydroelectric plants produce about 34 gigawatthours annually which is about 5% of the forecasted 1978 energy requirement. There are two flood control projects in the basin. About 38% of the basin's installed hydroelectric capacity is developed in the 2,400 kw Upper Beaver plant. The Upper Beaver plant is in good condition and capable of being operated efficiently for a number of years in the future. It is not considered to be economically justified for the company to make repairs for resumed power production at the Lower Beaver plant. Water resource projects which have been considered for development include: a land rehabilitation program; a water diversion project; two pumped storage projects, and two low-head hydroelectric powerplants. (Moore-SRC)
W82-04636

THE WELSH APPROACH TO WATER RECREATION,
S. Le Lievre.
Water, No 42, p 29-31, 1982. 3 Fig.

Descriptors: *Water use, *Recreation, *Water demand, Boating, Fishing, Lakes, Reservoirs, *Wales, Regulations.

The Welsh Water Authority Strategic Plan for Waterspace Recreation and Amenity was recently released. Representative bodies of users and individuals with interests in countryside conservation and wildlife protection have given unequivocal approval and support to the authority's proposals, which took six years to complete. Uppermost in the minds of the authority is the conservation of the countryside in which the visible assets of water space are located. Much of the time taken in preparing the master plan was occupied in consultations with all types of users, in order to search for practical solutions to possible areas of conflict or clashes of interest. (Baker-FRC)
W82-04658

THE SEVEN-TRENT STUDIES OF INDUSTRIAL WATER USE,
Severn-Trent Water Authority, Birmingham (England).
J. E. Thackray, and G. G. Archibald.
Proceedings of the Institution of Civil Engineers, Part 1: Design and Construction, Vol 70, No 2, p 403-434, August, 1981. 9 Fig, 22 Tab, 16 Ref.

Descriptors: *Water use, *Industrial water, Water consumption, *Water demand, *Municipal water, Water reuse, Wastewater disposal, Economic aspects, *Severn-Trent Water Authority, Water prices, *England.

An extensive investigation of industrial and commercial water usse in the Severn-Trent Water Authority region involved a detailed survey of water use practices and policies of 3000 metered consumers. The proportions of piped water and directly abstracted water used by different industries are reported. Average annual metered consumption in the region rose from 550 million/liters per day in 1965 to 625 million liters per day in 1970, declined sharply to 525 million liters per day in 1977, and increased slightly to 575 million liters per day in the late 1970's. A table of water use classified by 18 different processes (cooling, product rinsing, gas scrubbing, etc.) in 16 industry categories (mining, food, chemicals, etc.) is presented. Water use per employees in manufacturing industries averaged 2065 liters per day, with wide variations. Domestic type water use by persons at work in industry averaged 96 liters per person per day, slightly less than the average household per capita consumption, 115-120 liters per day. Other tables and figures concern water use per unit of manufacturing output, water charges as a percentage of total costs, water saving schemes used in industry, elasticity of demand with respect to output, water recycling, average water use in service industries, and disposal of used water. This information base is usable by those involved in economic appraisals and in forecasting and design of facilities for water suppliers and consumers. (Cassar-FRC)
W82-04686

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
T. F. McLoughlin.
Journal of the New England Water Works Association, Vol 95, No 4, p 271-279, December, 1981. 2 Ref.

Descriptors: *Water supply, *Water resources development, *Massachusetts, *Water demand, Conservation, *Water quality, Industrial wastes, Aquifers, Financial aspects.

Water supply priorities are discussed, including impacts of hazardous waste on water supply, protection of existing and future aquifers, water conservation, regionalization, and budgetary constraints. Drinking water supplies in at least one-third of the communities in Massachusetts have been affected by organic chemical contamination to some degree, resulting in the closure of wells in 22 communities, with capacity losses averaging 40% and ranging as high as 100%. Increasing demands on groundwater supplies must be met with safeguards to protect the aquifers from further contamination. Fluctuations in groundwater levels are caused by a number of factors, including seasonal variations, changes in river and stream stages, various forms of withdrawal, and recharge. Tremendous efforts are underway to explore traditional and non-traditional sources of water supply. However, the need for conservation is clear. Water conservation programs can benefit water quality and quantity in various ways, including financial savings for the municipality as well as the individual homeowner. Regionalization is another name for sharing resources. This type of approach has great potential in solving supply and demand issues in the state of Massachusetts. Various factors to be considered include adequacy and reliability, quality, cost, legality and politics. (Baker-FRC)
W82-04698

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3D.
W82-04728

A METHOD FOR ESTIMATING PEAK WATER DEMAND OF MULTIFAMILY RESIDENCES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, P. Boucher, and H. Demard.
Water Resources Bulletin, Vol 16, No 4, p 729-737, August, 1980. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Peak demand, *Domestic water, Apartments, *Water demand, *Statistical analysis, Water pressure.

Peak water demand for apartment residences of three or more units was estimated from the square root of the number of apartment units in the building and the cube root of water pressure. This relationship was obtained from statistical analysis of data from 17 apartment buildings, 3 to 41 apartments each, in Sainte-Foy, Quebec, using the Ridge-regression technique. The formula may be applied to the eastern U.S., where appliances, pressure conditions, and mean water demands are similar to those used in the study. Oversizing of meters and service lines increases maintenance costs, underregisters low demand, and requires a large initial investment. Undersizing the equipment leads to increases in friction loss, possible damage to the meter, and undercapacity. (Cassar-FRC)
W82-04734

LIBRARY U. OF I.- URBANA-CHAMPAIGN

FINANCING FEDERAL WATER DEVELOPMENT PROJECTS AND SHARING THE COSTS,
Water Resources Council, Washington, DC.
R. M. Wheeler, L. M. Eisel, and G. D. Seinwill.
Water Resources Bulletin, Vol 16, No 2, p 326-335, April, 1980. 5 Fig, 20 Ref.

Descriptors: *Financing, *Water supply development, *Cost sharing, Water management, Planning, Administration, Political aspects, *Federal jurisdiction, Economic aspects.

A brief survey is presented of past and present Federal involvement in water resources development, along with a closer look at the nature of cost sharing and an assessment of the varied assortment of existing Federal and non-Federal cost sharing provisions. Samplings of some relevant emerging issues are presented, with the focus on policy questions that are currently arising due to competing interests for water and water project funding. Several proposed strategies for dealing with cost sharing policy reform are discussed, with detailed emphasis on two current proposals under consideration. The joint venture approach results in an effective composite cost share which changes significantly but not drastically, from 19 to 35% non-Federal share for a hypothetical project. The block grant approach would alter the regional distribution of Federal water development funding from the South and West to the Northwest and North Central States. To be successful any strategy not only must be theoretically sound, but must be politically sound as well. Practical solutions must be sought through the existing political structure, as any realistic solution generally requires the transfer of a subsidy from one interest to another. (Baker-FRC)
W82-04739

THIRD-DEGREE PRICE DISCRIMINATION AND REGULATION IN THE MUNICIPAL WATER INDUSTRY,
Lafayette Coll., Easton, PA.
T. H. Bruggink.
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Water, No 42, p 29-31, 1982. 3 Fig.

Descriptors: *Water use, *Recreation, *Water demand, Boating, Fishing, Lakes, Reservoirs, *Wales, Regulations.

The Welsh Water Authority Strategic Plan for Waterspace Recreation and Amenity was recently released. Representative bodies of users and individuals with interests in countryside conservation and wildlife protection have given unequivocal approval and support to the authority's proposals, which took six years to complete. Uppermost in the minds of the authority is the conservation of the countryside in which the visible assets of water space are located. Much of the time taken in preparing the master plan was occupied in consultations with all types of users, in order to search for practical solutions to possible areas of conflict or clashes of interest. (Baker-FRC)
W82-04658

THE SEVEN-TRENT STUDIES OF INDUSTRIAL WATER USE,
Severn-Trent Water Authority, Birmingham (England).
J. E. Thackray, and G. G. Archibald.
Proceedings of the Institution of Civil Engineers, Part 1: Design and Construction, Vol 70, No 2, p 403-434, August, 1981. 9 Fig, 22 Tab, 16 Ref.

Descriptors: *Water use, *Industrial water, Water consumption, *Water demand, *Municipal water, Water reuse, Wastewater disposal, Economic aspects, *Severn-Trent Water Authority, Water prices, *England.

An extensive investigation of industrial and commercial water usse in the Severn-Trent Water Authority region involved a detailed survey of water use practices and policies of 3000 metered consumers. The proportions of piped water and directly abstracted water used by different industries are reported. Average annual metered consumption in the region rose from 550 million/liters per day in 1965 to 625 million liters per day in 1970, declined sharply to 525 million liters per day in 1977, and increased slightly to 575 million liters per day in the late 1970's. A table of water use classified by 18 different processes (cooling, product rinsing, gas scrubbing, etc.) in 16 industry categories (mining, food, chemicals, etc.) is presented. Water use per employees in manufacturing industries averaged 2065 liters per day, with wide variations. Domestic type water use by persons at work in industry averaged 96 liters per person per day, slightly less than the average household per capita consumption, 115-120 liters per day. Other tables and figures concern water use per unit of manufacturing output, water charges as a percentage of total costs, water saving schemes used in industry, elasticity of demand with respect to output, water recycling, average water use in service industries, and disposal of used water. This information base is usable by those involved in economic appraisals and in forecasting and design of facilities for water suppliers and consumers. (Cassar-FRC)
W82-04686

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
T. F. McLoughlin.
Journal of the New England Water Works Association, Vol 95, No 4, p 271-279, December, 1981. 2 Ref.

Descriptors: *Water supply, *Water resources development, *Massachusetts, *Water demand, Conservation, *Water quality, Industrial wastes, Aquifers, Financial aspects.

Water supply priorities are discussed, including impacts of hazardous waste on water supply, protection of existing and future aquifers, water conservation, regionalization, and budgetary constraints. Drinking water supplies in at least one-third of the communities in Massachusetts have been affected by organic chemical contamination to some degree, resulting in the closure of wells in 22 communities, with capacity losses averaging 40% and ranging as high as 100%. Increasing demands on groundwater supplies must be met with safeguards to protect the aquifers from further contamination. Fluctuations in groundwater levels are caused by a number of factors, including seasonal variations, changes in river and stream stages, various forms of withdrawal, and recharge. Tremendous efforts are underway to explore traditional and non-traditional sources of water supply. However, the need for conservation is clear. Water conservation programs can benefit water quality and quantity in various ways, including financial savings for the municipality as well as the individual homeowner. Regionalization is another name for sharing resources. This type of approach has great potential in solving supply and demand issues in the state of Massachusetts. Various factors to be considered include adequacy and reliability, quality, cost, legality and politics. (Baker-FRC)
W82-04698

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3D.
W82-04728

A METHOD FOR ESTIMATING PEAK WATER DEMAND OF MULTIFAMILY RESIDENCES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, P. Boucher, and H. Demard.
Water Resources Bulletin, Vol 16, No 4, p 729-737, August, 1980. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Peak demand, *Domestic water, Apartments, *Water demand, *Statistical analysis, Water pressure.

Peak water demand for apartment residences of three or more units was estimated from the square root of the number of apartment units in the building and the cube root of water pressure. This relationship was obtained from statistical analysis of data from 17 apartment buildings, 3 to 41 apartments each, in Sainte-Foy, Quebec, using the Ridge-regression technique. The formula may be applied to the eastern U.S., where appliances, pressure conditions, and mean water demands are similar to those used in the study. Oversizing of meters and service lines increases maintenance costs, underregisters low demand, and requires a large initial investment. Undersizing the equipment leads to increases in friction loss, possible damage to the meter, and undercapacity. (Cassar-FRC)
W82-04734

LIBRARY U. OF I.- URBANA-CHAMPAIGN

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,
Western Washington Univ., Bellingham. Dept. of Economics.
R. Frye, and J. W. McFarland.
Water Resources Bulletin, Vol 16, No 1, p 31-35, February, 1980. 10 Ref.

Descriptors: *Water demand, *Water conservation, *Economic aspects, Computers, Water resources development, Resources development, *Rhode Island, Water supply, Water supply development, Water requirements, Model studies, Pricing.

Two approaches are considered to a residential water supply problem being experienced in Rhode Island. The first approach is a benefit maximization model incorporating price sensitive water demand as the basis for measuring system benefits. This is contrasted with a 'requirements' approach, which is a cost minimization model constrained b the requirement to provide a minimum quantity per household. To reconcile the differences between the results of the two approaches, a modification is made in the benefit-maximization approach to include peak demand considerations. The study focuses on Newport, Middletown, and Portsmouth, Rhode Island, located on Aquidneck Island in Narragansett Bay. Results indicate that a requirements approach can lead to findings similar to a benefit maximization model incorporating price sensitive demand. Incorporating price sensitive demand also leads to ambiguous results due to not knowing which demand function to use as a measure of benefits or how to construct such a function. The findings do confirm that dynamic programming is a useful way of formulating the intertemporal investment-production problem in different sources of supply and/or capital components exhibiting differing economies of scale. The method allows explicit consideration of the tradeoffs between the costs of periods of excess capacity and economies of scale for a number of components. The choice of an objective function requires flexibility; benefit maximization and cost minimization can lead to similar or dissimilar results, depending on the flexibility of the analyst and the model. (Baker-FRC)
W82-04740

6E. Water Law and Institutions

WATER MANAGEMENT IN ONTARIO,
Ontario Ministry of the Environment, Toronto.
S. E. Salbach, and R. P. Dennis.
Water Resources Bulletin, Vol 16, No 4, p 621-262, August, 1980.

Descriptors: *Water management, *Regulations, *Water policy, *Water quality standards, Management, *Ontario, Groundwater, Surface water, Effluent standards, Water allocation, Water pollution control.

The Ontario Ministry of the Environment revised its 1970 guidelines for water quality management in 1976 as a response to changes in the social and economic background, advances in technology, and philosophical attitudes toward water management. Goals, objectives, and policies to implement the goals are given for management of surface water quality and quantity and groundwater quality and quantity. For example, the goal for surface water quality is to ensure that the surface waters of the province are of a qality which is satisfactory for aquatic life and recreation. The policies for implementation concern areas with water quality better than the objectives, areas with water quality not meeting the objectives, effluent requirements, hazardous subsurfaces, and mixing zones. The revised approach involves imposition of legally enforceable effluent requirements on a case-by-case basis rather than having province-wide effluent standards. Five working groups are developing the necessary detailed implementation procedures. (Cassar-FRC)
W82-04259

OBJECTIVES AND CONSTRAINTS IN FEDERAL WATER RESOURCES PLANNING,
Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Resources Bulletin, Vol 17, No 6, p 1060-1065, December, 1981. 6 Ref.

Descriptors: *Planning, *Decision making, *Political constraints, Water Resources Council, Water resources development, Economic development, Environmental quality, *Water policy, Public participation.

The Water Research Council's 1973 'Principles and Standards' states that plans should be formulated to reflect national, regional, state, and local needs or problems consistent with the objectives of improvements in national economic development and environmental quality. There is no specified approach to reconciling national objectives with local needs and problems. Increasingly, the approach has been to plan with national objectives as the first consideration. This is not the most practical or desirable method, partly because the national objectives are general and abstract. Many conflicts between the federal government and local groups have arisen over water resources development projects. A more satisfactory planning method is to formulate plans for solving a specific local problem and then consider the restraints imposed by the national objectives. Public participation on the local level is recommended. (Cassar-FRC)
W82-04288

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,
Oklahoma State Univ. Stillwater. Dept. of Economics.
R. L. Moomaw, and L. Warner.
Water Resources Bulletin, Vol 17, No 6, p 1029-1034, December, 1981. 1 Tab, 11 Ref.

Descriptors: *Water conservation, *Institutional constraints, *Pricing, *Municipal water, Water rates, Planning, Nonstructural alternatives, Water policy, Profit, Political aspects.

Municipal water utilities are unlikely to voluntarily adopt water conservation practices which reduce net revenues, even if they are beneficial in the long term. Institutional changes are suggested. Decisions involving decreases of revenues (pure conservation measures such as new plumbing codes, education, and retrofitting) should be removed from the water enterprises jurisdiction. Subsidies to the water company for improved management practices such as meter repair and leak control may increase chances for adoption of these conservation measures, even though they decrease revenues. Conservation pricing (overall rate increase, summer surcharges, and flat rates) increase water company revenues but may create illegal or unpopular profits. Laws can be changed to allow use of such profits for property tax relief or other acceptable programs. A study of five Texas and Louisiana cities illustrates some of these alternatives. All these cities have had recent water increases of 10% to 35%, and all but one had sewer increases from 35% to 140%. There is also a trend toward conservation by better management and maintenance. Only one city adopted measures that cost the utilities money and decreased short-term revenues. (Cassar-FRC)
W82-04343

THREE IMPORTANT COURT DECISIONS,
Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Water Resources Bulletin, Vol 17, No 6, p 1097-1098, December, 1981.

Descriptors: *Judicial decisions, *Landfills, *Effluent standards, Water law, *Water management, Chemical wastes, Waste disposal, Cost-benefit analysis, Permits, *Illinois.

Three court decisions of concern in water management are reported. In the Village of Wilsonville v. SCA Services, Inc., the Illinois Supreme Court affirmed a lower court decision to close a hazardous waste landfill located in a coal mine subsidence zone because it threatened groundwater quality. The argument that the landfill site and all disposals had state EPA approval were rejected because permits were allegedly based on inaccurate data. In Issac Walton League v. Marsh a federal court of appeals refused to review the cost-benefit analysis for the Army Corps of Engineers Locks and Dam 26 Project on the Mississippi River near Alton, Illinois, thus allowing the project to preceed as authorized. The American Paper Institute v. EPA case invalidated the Environmental Protection Agency regulations for industrial effluent discharges based on best conventional pollutant control technology (BCT). It is likely that little progress beyond Phase I, best practicable technology (BPT), will be seen in the near future. (Cassar-FRC)
W82-04349

THE WINTERS DECISION AND INDIAN WATER RIGHTS--A MYSTERY REEXAMINED,
California Univ., Los Angeles. Dept. of History.
N. Hundley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211525, Price codes: A03 in paper copy, A01 in microfiche. March, 1982. 31 p, 77 Fig. OWRT A-059-CAL(3).

Descriptors: *Legal aspects, *Water rights, *Judicial decisions, *History, *Indian reservations, Western United States, Semiarid lands.

Water is the natural resource of greatest concern in western American, an area of few rivers, sparse rainfall, and monumental struggles over the precious commodity. Joining increasingly in the struggles have been Native Americans, most of whose reservations and reservation population are found in the driest portions of the region. No less concerned are non-Indians whose cities, industries, and farms are already using most of the West's water. At the heart of these controversies, both past and in-th-making, are differences over a 1908 decision rendered by the United States Supreme Court in Winters v. United States. That decision announced for the first time the existence of an Indian water right, but the meaning of the court's action has become clouded in debate which has exacerbated conflicts between Indians and non-Indians and created a crisis of national significance. For more than half a century, attorneys, legal scholars, and historians have quarreled over the meaning to the Winters decision with three issues in particular dominating their differences: the quantum or volume of the Indian right, the legitimate uses to which the water guaranteed by the right can be put, and the priority of the right in relation to the rights of non-Indians desirous of the same water sources. Careful examination of published documents and heretofore overlooked manuscript materials helps to clarify the intentions of the Winters court and to shed light on the ongoing disputes over the Indian water right. (Snyder-California)
W82-04410

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
D. H. Kickox.
Water Resources Bulletin, Vol 16, No 5, p 797-803, October, 1980. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Water law, *Montana, *Water resources development, *Water rights, Water requirements, Legal aspects, Water use, Water policy, State jurisdiction, *Water demand, Water supply, Riparian rights, Reservoir storage, Irrigation requirements, Future planning, Coal, *Tongue River basin.

The extensive development of coal deposits in Southeastern Montana's Tongue River basin has created a great demand on the area's water resources. In some areas not enough water is available to meet demands, while in other cases, even though water is in abundance, it may not be legally available due to a new Montana water allocation system, Indian lawsuits, or state policy toward water resource development. Some energy proj-

ects threaten to dewater the river, degrade water quality and endanger aquatic ecosystems. The Montana Water Use Act was enacted in 1973 to end the uncertainties existing in Montana water law by requiring final allocation and adjudication of the state's waters. In 1974, the Water Moratorium Act was passed to allow the state time to plan for future water use. In 1978, plans were made for the Tongue River Reservoir, which will soon be replaced by a larger dam and reservoir. Irrigation districts will be allotted all the water they have requested. The Fish and Game Department has requested enough water to maintain instream flows. Processing of industrial applications for water began in 1979. The Montana Water Storage Company and the Water Reserve Company have both requested large diversions that cannot be met by the available water in the Tongue River. Industrial allotments will probably continue to take a second place to preferred agricultural water uses in Montana. (Geiger-FRC)
W82-04441

DEVELOPMENT OF FEDERAL RESERVE RIGHTS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
J. W. Bird.
Water Resources Bulletin, Vol 16, No 5, p 837-842, October, 1980.

Descriptors: *Federal jurisdiction, *Water rights, *Water law, *Arid zone hydrology, *Reservation doctrine, Flood control, Water management, Legal aspects, Riparian rights, Water policy, Water supply, Water use, Navigable waters, Arid lands.

States in arid regions are concerned over the federal reserved rights termed 'Indian Rights to Water', which include such concepts as navigation improvement and flood control plans. Recently a large number of lawsuits concerning water based on the Winters' Doctrine been filed in arid states. The protection of federal reserved water rights can be seen in such landmark cases as the U.S. vs. Rio Grande Dam and Irrigation Company (1899), Winters vs. U.S. (1908), Federal Power Commission vs. Oregon (1955), Arizona vs. California (1963), and U.S. vs. District Court for Eagle County (1971). The existing lawsuits on surface water sources such as the one now on appeal involving reserved federal rights on the Truckee River have promulgated two standards for deciding on the use of reserved waters. Those uses needed to fulfill the purposes contemplated when the reservation was created will be considered under one plan, while all possible uses, including those which appear in the future, without reference to the purposes for which the reservation was created, will form a second plan for reserved water use. The first plan allows a rapid quantification of the reserved water rights to identify and protect a certain amount of water from others. In the second case, the Indians' rights would remain uncertain, and the courts may be able to force the Indians to accept compensation for their claim if no water is available. (Geiger-FRC)
W82-04446

NEW FEDERAL WASTEWATER DISCHARGE STANDARDS IN GERMANY,
Ministry of the Interior, Berlin (Germany, F.R.).
H. Hornef, and S. Kanowski.
Effluent and Water Treatment Journal, Vol 21, No 11, p 510, 511, 513, 514, November, 1981. 2 Tab, 2 Ref.

Descriptors: *Wastewater disposal, *Regulations, Standards, *Federal jurisdiction, *Industrial wastes, Water quality, *Water pollution control, *West Germany.

The federal government in Germany has enacted two general laws which emphasize the principle of precaution and the need for those who do the polluting to pay for the cost of cleanup. The Wastewater Charges Act rules that a fee has to be paid for discharging wastewater into receiving waters. This charge may be reduced by 50% if the minimum quality requirements are met. The minimum requirements are compulsory everywhere in the Federal Republic of Germany and are independent of the state of the receiving waters. These requirements are generally emission standards in the form of concentrations and/or load of pollutants specific for products. In 1977 the federal government established 50 task forces to develop proposals for minimum requirements on an industry-by-industry basis. The most important pollutants/parameters for which minimum requirements are to be fixed are those for which a wastewater charge has to be paid, including settleable solids, chemical oxygen demand, cadmium, mercury, and toxicity for fish. In specific branches requirements will be set for biochemical oxygen demand, hydrocarbons, phenols, cyanide, heavy metals, halogenated hydrocarbons, sulfide, ammonia, fluoride, phosphorus, and total suspended solids. State authorities will set requirements for pH and temperature parameters. (Baker-FRC)
W82-04527

EXPERIENCES WITH EEC GUIDELINE 75/440 ON THE QUALITY OF SURFACE WATERS FOR DRINKING WATER PRODUCTION IN THE MEMBER STATES (ERFAHRUNGEN MIT DER EG RICHTLINIE 75/440 UBER DIE QUALITAT VON OBERFLACHENWASSER FUR DIE TRINKWASSERGEWINNUNG IN DEN MITGLIEDSTAATEN).
GWF-Wasser/Abwasser, Vol 122, No 12, p 555-560, 1981. 5 Fig. English Summary.

Descriptors: *Legal aspects, *Water quality standards, *European Economic Community, International law, Drinking water, Potable water, Surface water, Water quality, Lead.

The European Economic Community (EEC) Council of Ministers' guidelines on surface water quality for drinking water, published in 1975, is critically reviewed. This guideline had a dual goal of preventing water pollution and protecting public health. Some European water managers have expressed the opinion that this guideline offers more hindrance than help. Implementation in many countries has placed the burden of assuring acceptable source quality on the water supply enterprise and has failed sufficiently to emphasize pollution prevention. Some water obtainment treatment techniques widely used in Europe are not covered by the guideline. No encouragement is provided for improving water quality beyond minimum standards. Not all of the recommended methods and standards are adequately defined. Since this guideline is in the process of being adopted in legislation of the EEC member countries, it is advisable that these problems be resolved as soon as possible. (Carroll-FRC)
W82-04547

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.
Franklin Pierce Law Inst. Center, Concord, NH.
For primary bibliographic entry see Field 6B.
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.
Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-45, Price codes: A03 in paper copy, A01 in microfiche. DOE/CE/04934-45, March, 1981. 39 p, 1 Tab.

Descriptors: *Hydroelectric plants, *Legal aspects, *Economic aspects, *Local givernments, Financing, Permits, Licensing, Dams, Construction, Feasibility studies, Legislation.

This manual is designed to provide guidance to towns, cities, counties and other political subdivisions which are interested in undertaking or participating in small scale hydroelectric (SSH) development within or close to their territorial boundaries. A SSH project is of 25 to 30 MW or less and utilizes an existing dam or structure or utilizes the site characteristics of partially breached dams or structures. Since 1978 new federal legislation has removed some of the obstacles to SSH projects and has created substantial incentives for development. The hydroelectric development process can be braken down into the following sequential steps: reconnaissance study: feasibility study; permits, licensing, and exemptions study; engineering design; power purchase negotiations; construction; and operation. Every political subdivision must examine its charter or enabling legislation in order to determine whether it is authorized to proceeed with development of a SSH project. Assuming the requisite authorization exists, the political subdivision may choose to be the sole owner, developer and operator, in which case the financing and other arrangements are straight-forward. Assuming state or local law permits, the political subdivision may consider joint development with a private development firm, the local investor owned utility or another political subdivision. Disposition of a site owned by a political subdivision can take a variety of forms: outright sale at auction, sale of an option to purchase, a lease resulting from a bidding system, or a management and development contract resulting from a competitive proposal system. Since at least 80% of the annual cost of a hydroelectric project consists of interest payments and capital amortization expenses, it is important to select a financing strategy that minimizes the cost of financing the project. (Moore-SRC)
W82-04634

APPLICATION OF THE AREA OF REVIEW CONCEPT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Thornhill, T. E. Short, and L. Silka.
Ground Water, Vol 20, No 1, p 32-38, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Injection wells, *Water quality control, *Mathematical studies, *Computer models, *Oil wells, *Hydrostatic pressure, Groundwater management, Water quality management, Model studies, Digital computers, Aquifers, Groundwater movement, Drinking water, Injection wells, Regulations.

Underground Injection Control regulations require that the issuers of permits determine, within an 'area of review', whether a proposed injection operation has a potential for contaminating underlying or overlying aquifers through faults, wells, or other conduits that permeate the injection zone. The 'area of review' is defined as that area the radius of which is the lateral distance from an injection well or injection well pattern in which the pressure change due to injection operations may cause the migration of the injection and/or formation fluid into an underground drinking water supply. It is thus the area around an injection well where, during injection, the hydrostatic head of the formation fluid in the injection zone is equal to or greater than the hydrostatic head of underground sources of drinking water. A Theirs equation may be used to determine the zone of endangering influence to define the area of review. The concept was applied to Texas oil fields in Anderson County, Andrews County and Refugio County, where active injection wells already existed and sufficient data was available to determine the area of review. The Warner analytical method for determining pressure buildup and a programmable desk calculator and digital computer were used in this exercise. In studying areas that have numerous injection wells discharging into the same zone, it was suggested that the effect of all the wells on the pressure buildup be considered. (Geiger-FRC)
W82-04674

RECENT DEVELOPMENTS IN COLORADO GROUNDWATER LAW,
Davis, Graham and Stubbs, Denver, CO.
F. Hannay.
Denver Law Journal, Vol 58, No 4, p 801-823, 1981. 194 Ref.

Descriptors: *Water law, *Wells, *Water rights, *Colorado, *Groundwater management, *State jurisdiction, *Appropriation, Legal aspects, Riparian

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rights, Water use, Tributaries, Surface water, Water allocation, Resources development, Water management, Equitable apportionment, Permits.

The developments in Colorado water law with respect to both tributary and nontributary groundwater are reviewed. Tributary groundwater is defined as any surface and underground water of the state that would affect the rate of flow of the natural stream into which it flows over a period of forty years or less. A case in which the use of groundwater for two wells would have affected the rate and flow of the Cache La Poudre River helped establish the definition of tributary groundwater. If a well's operation would not affect the flow in a stream until one hundred years or more after the commencement of pumping, such a water supply would be defined as nontributary groundwater. In 1965, House Bill 1066 gave the state engineer the authority to control existing and new wells in Colorado. The 1969 Water Rights Determination and Administration Act served to implement and refine the doctrine of maximum water utilization while preserving vested rights. Recent court cases which sought to clarify the 1969 Act were unsuccessful at this task. The Colorado Supreme Court must still decide if nontributary groundwater can be appropriated, and, if so, how and by whom. (Geiger-FRC)
W82-04679

BUBB V. CHRISTENSEN: THE RIGHTS OF THE PRIVATE LANDOWNER YIELD TO THE RIGHTS OF THE WATER APPROPRIATOR UNDER THE COLORADO DOCTRINE,
E. A. Rada.
Denver Law Journal, Vol 58, No 4, p 825-836, 1981. 88 Ref.

Descriptors: *Water rights, *Colorado, *Appropriation, *State jurisdiction, *Land tenure, Water law, Riparian rights, Legal aspects, Water use, Water allocation, Water management, Land rights.

The Colorado Doctrine, which was developed to permit maximum utilization of water, implies that a water right may be acquired separate from the land. This negates the importance of trespass in the determination of a valid water right as seen in the case of Bubb vs. Christensen. The private landowner's right to be protected against trespass is subordinate if the trespasser can clearly demonstrate his intent to appropriate water on or adjacent to another's property. The landowner's recovery will be limited only to damages rather than to denial of the appropriator's right to use the diverted water. If it can be demonstrated that the appropriator did not put the water to good use and wrongfully took the owner's land, then the landowner may obtain relief in a court of general jurisdiction in an action for trespass. The court decision handed down in Bubb vs. Christensen suggests that a private landowner's property may be taken by one holding a conditional water right without first making compensation to the owner. (Geiger-FRC)
W82-04680

NOTE, WATER FOR OIL SHALE: FRAMEWORK FOR THE LEGAL ISSUES,
C. Robinson, and M. E. Walta.
Denver Law Journal, Vol 58, No 4, p 703-714, 1981. 95 Refs.

Descriptors: *Oil industry, *Legal aspects, *Water quality, Water supply, Shales, Energy, *Oil shale, Water pollution sources, Industrial water, Process water, *Colorado.

The proposed oil shale industry in Colorado will have a significant impact on the limited water resources of the state in two vital respects - depletion of water quantity and degradation of water quality. Oil shale companies will compete with agriculture, municipalities, other industries and recreation for the state's limited water supplies and will face environmental concern over water systems already polluted by existing users and by nature. General information of a technical nature is presented about oil shale geology and technology in order to form a framework for the legal issues related to water for oil shale development. The paper considers water availability, geology of oil shale formation, technologies for shale development, water requirements of the industry, and anticipated water quality impacts. This background will facilitate understanding of the legal problems inherent in the acquisition and use of Colorado water. A multitude of legal problems will surface as the oil shale industry continues to seek adequate and dependable water supplies. These problems will be further compounded by the labyrinth of federal regulations and by Colorado's specialized water law system. Ultimate resolution of these legal questions by the courts will significantly influence Colorado's role in helping the United States achieve energy independence. (Baker-FRC)
W82-04681

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,
New Hampshire Water Supply and Pollution Control Commission, Concord.
S. W Leavenworth.
Journal of the New England Water Works Association, Vol 95, No 4, p 245-247, December, 1981.

Descriptors: *Reservoirs, *Water pollution prevention, Water supply development, Surface water, Water pollution sources, *Legal aspects, Public health, *Concord, *New Hampshire.

Problems encountered during efforts to secure a covering for a storage reservoir in the City of Concord, New Hampshire, are reviewed. In the summer of 1969 high levels of coliform bacteria were noted in water samples collected from the high service portion of the distribution system, while samples from other parts of the system were of a much better quality. The high service portion was served by a ground level uncovered storage reservoir with a capacity of about two million gallons. Application to install a cover was granted, but when funding finally became available, the priority of other projects was put above the reservoir cover and the project did not begin as planned. After a hearing before the Commission, the City was ordered to install a cover. The objections which the city had presented stemmed mainly from an epidemiologist's report that there had been no statistical evidence linking waterborne disease outbreaks to uncovered reservoirs. However, this approach to reasoning disregards the entire concept of prevention. There is also ample evidence that the various improvements in water treatment and in knowledge of water supply and distribution have reduced the incidence of waterborne disease outbreaks dramatically. Eventually in the City of Concord, the technical aspects took second place to the legal approach, as the order of the Commission was eventually appealed by the City to the State Supreme Court. In the final judgment, the Commission won, but more on legal grounds than on health and safety evidence. (Baker-FRC)
W82-04700

AUCTIONS AND ALTERNATIVE PROCEDURES FOR ALLOCATING POLLUTION RIGHTS,
Texas Univ. at Austin. Dept. of Economics.
R. M. Lyon.
Land Economics, Vol 58, No 1, p 16-32, February, 1982. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Water pollution control, *Legal aspects, *Water rights, Industrial wastes, *Regulations, Effluent charges, Effluent limitations.

This paper considers both potential strategic behavior of dischargers bidding for rights and price-taking behavior. Particular attention is given to examining the types of auction procedures that could be used to implement rights sales by the government, if the approach of government sales is adopted. A special type of auction, a type of roves mechanism, that discourages strategic bidding by dischargers is contrasted with auctions that use a single clearing price as a method for government sales. Regulatory procedures are considered, as they represent a standard against which programs involving transferable rights can be compared. Under the single-price auction rights would be sold to the highest bidders for a price that could represent either the lowest accepted bid or the highest rejected bid. A discriminating auction is designed specifically to eliminate dischargers' incentives for strategic bidding. Based on both theoretical and practical considerations, it is concluded that there is a fundamental trade-off between reducing the financial burden of rights purchases and eliminating the incentives for strategic behavior. Very few dischargers in either of the two case studies presented would have lowered expenses under government sales of rights rather than under uniform treatment regardless of whether sales are by a single-price or incentive-compatible auction. The simulations also suggest that there may be opportunities for strategic behavior under nonincentive-compatible procedures because of small numers of dischargers. The rights allocation approach of free distribution followed by exchange may present the most desirable package of features. (Baker-FRC)
W82-04746

6F. Nonstructural Alternatives

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,
Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 5F.
W82-04350

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
For primary bibliographic entry see Field 6D.
W82-04698

FLOOD HAZARD IDENTIFICATION AND FLOOD PLAIN MANAGEMENT ON ALLUVIAL FANS,
Army Engineer Div. North Pacific, Portland, OR.
L. M. Hagura, and D. E. Wood.
Water Resources Bulletin, Vol 16, No 1, p 56-62, February, 1980. 8 Fig, 6 Ref.

Descriptors: *Flood control, *Alluvial fans, Alluvial plains, Sedimentary structures, Floods, United States, Land management, *Flood plains, Flood plain management, California.

This paper focuses on a special study procedure that the Federal Insurance Administration (FIA) has developed and is requiring its flood insurance study contractors to utilize for identifying alluvial fan (AF) zones. The need for an appropriate AF hazard identification procedure was dramatically emphasized by the passage of Tropical Storm Kathleen over the desert areas of Southern California in September of 1976. The pattern of flood damage was more typical of midwestern tornado damage, with certain localities extremely hard hit and other adjacent communities experiencing little or no structural damage. The basic cause of the substantial flood damage was a failure on the part of the local planning and building officials and developers to recognize the true degree of flood hazard that exists on alluvial fans. The procedure is understandably crude compared to other flood hazard identification techniques applied to more conventional flood problems. (Baker-FRC)
W82-04738

6G. Ecologic Impact Of Water Development

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W82-04439

MODELING THE ENVIRONMENTAL EFFECTS OF A NAVIGATION CHANNEL IN A TIDAL BAY,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, R. W. Hall, and C. J. Newell.
Water Resources Bulletin, Vol 16, No 5, p 881-886, October, 1980. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Navigation canals, *Environmental effects, *Model studies, Mathematical models, Salinity, Simulation, Channels, Tidal basins, Hydrologic models, *Tidal waters, Bays, Louisiana, Vermilion Bay, New Iberia.

This paper documents the use of a mathematical bay model to predict the environmental impacts of a proposed navigation channel from the Port of New Iberia, Louisiana, to the Gulf of Mexico through Vermilion Bay. Although these large bays cover an area of 293,895 acres, they are rather shallow, with depths averaging 5 to 7 feet. Models wer used to predict the changes in flow and salinity in the bay system under a variety of flow, wind, and channel conditions. The major assumptions in the model were that the bay is vertically well mixed, significant variations in depth from cell to cell do not occur at more than a few places in the bay, Atchafalaya inflows do not appreciably alter the tidal variation input to West Cote Blanche Bay, salinities are based on tidally averaged flows and do not represent actual peaks and lows within a tide cycle, and source salinities and source tides are assumed to correspond, although actual data were not simultaneously available for both. The model predicted that average salinity in the Vermilion Bay system would decrease with both high south winds and high fresh water inflows when compared to standard conditions. With a navigation channel incorporated in the model, average bay salinities were predicted to be lower for all three simulation cases. This project also pointed out the crucial role of complete input data in the effective appraisal of major projects such as the Vermilion Bay channel. Environmental impacts of major projects do not always follow the course of similar projects, as seen by the Vermilion Bay model results when compared to other channels constructed on the Gulf Coast. (Baker-FRC)
W82-04449

SIMULATED HYDROLOGIC EFFECTS OF POSSIBLE GROUND-WATER AND SURFACE-WATER MANAGEMENT ALTERNATIVES IN AND NEAR THE PLATTE RIVER, SOUTH-CENTRAL NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
A. W. Burns.
Geological Survey Open-File Report 81-1116, 1981. 41 p, 21 Fig, 5 Tab, 10 Ref, Append.

Descriptors: *Surface-groundwater relations, *Wildlife habitats, *Water management, Wetlands, Aquifers, Groundwater recharge, Streamflow, Irrigation, *Nebraska, *Platte River.

Digital computer models were developed and used to simulate the hydrologic effects of hypothetical water-management alternatives on the wetland habitat area near Grand Island, Nebr. Areally distributed recharge to and discharge from the aquifer system adjacent to the Platte River between Overton and Grand Island were computed for four hypothetical water-management alternatives. Using stream-aquifer response functions, the stream depletions resulting from the different alternatives ranged from 53,000 acre-feet per year for increased surface-water irrigation to 177,000 acre-feet per year for increased ground-water pumpage. Current conditions would result in stream depletions of 125,000 acre-feet per year. Using the relationship between discharge and river stage, frequency curves of the stage in the river near the wildlife habitat area were computed using a 50-year sequence of historical streamflow at Overton, minus the stream depletions resulting from various management practices. For the management alternatives previously discussed, differences in the stage-frequency curves were minimal. For comparative purposes, three additional water-management alternatives whose application would change the incoming streamflow at Overton were simulated. Although in these alternatives the amounts of water that were diverted or imported were similar to the amounts in the previous alternatives, their effects on the stage-frequency curves were much more dramatic. (USGS)
W82-04509

INERTIA AND RECOVERY: AN APPROACH TO STREAM CLASSIFICATION AND STRESS EVALUATION,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 16, No 1, p 72-78, February, 1980. 2 Fig, 3 Tab, 36 Ref.

Descriptors: *Stream classification, *Stress, *Fish, Classification, Elastic properties, *Ecosystems, Biological communities, Water management, Streams, Inertia.

The feasibility of using a system based on inertia and elasticity was examined, and these concepts were applied to fish data collected by Hocutt and Stauffer on Conowingo Creek. For the purposes of the study, Conowingo Creek was divided into four sections based on stream order and gradient. The concept of inertia and elasticity was able to be used to formulate a stream classification system, which can predict the amount of stress a particular system can assimilate and the potential of a system to recover if and when the assimilative capacity is exceeded. In this example a stress at any of the upstream locations would probably affect downstream areas, and therefore both inertia and elasticity indices would be more realistic if calculated for separate tributaries of a major drainage basin. These types of analyses must be applied to various ecosystems using different phyletic groups before this system can be fully evaluated. In this study fish were used because they occupy the top of the food chain in most stream systems, and thus their presence implies the presence of many other phyletic groups. Fish also pass through most, if not all trophic levels above the primary producer stage as their development proceeds from larvae through adults. Inertia appeared to be a more useful concept than elasticity for predicting the effects of potential stress. The relationship between structural and functional redundancy and their influences on the inertia index are discussed. (Baker-FRC)
W82-04735

MAN-MADE STORAGE OF WATER RESOURCES-A LIABILITY TO THE OCEAN ENVIRONMENT. PART I,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
H. J. A. Neu.
Marine Pollution Bulletin, Vol 13, No 1, p 7-12, January, 1982. 11 Fig, 11 Ref.

Descriptors: *Ecological effects, *Water storage, *Runoff cycle, *Cycling nutrients, *Electric power production, Runoff, Seasonal variation, Estuaries, Salinity currents, Saline-freshwater interfaces, Tidal marshes, Continental shelf, Density currents.

The storage of spring and summer runoff to generate electric power may pose a serious threat to the freshwater supply required by estuaries, embayments, marshes, and continental shelves for the mixing and entrainment of nutrient-rich deep water into the surface layer. Along the northeastern United States and the eastern coast of Canada, the typical winter runoff of freshwater is small, but the spring and summer freshwater runoff into the estuaries is much larger. Reducing the flow of freshwater during spring and summer and increasing it during winter alters the seasonal composition of the water in the surface layer and the seasonal strength of the density current. Studies of salinity in the south side of Cabot Strait before regulation commenced, and in the 1970's after runoff regulation showed that drastic increases in salinity occurred after regulation and much of the cyclic variation in salinity had disappeared. If the trend continues, the cyclic variation will be reversed, summer and winter temperatures will probably increase and the strength of the density current may decline to the point of disappearance. Reductions in the transport of salt water will be accompanied by a decrease in the influx of nutrients during the active season of the year. (Geiger-FRC)
W82-04749

7. RESOURCES DATA

7A. Network Design

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 2L.
W82-04591

A DATA ACQUISITION SYSTEM FOR RECORDING AND PROCESSING RIVER QUALITY MONITORING DATA,
Severn Trent Water Authority, Coventry (England).
J. Cope.
Water Science and Technology, Vol 13, No 11/12, p 699-706, 1981. 13 Ref.

Descriptors: *Rivers, *Water quality, *Monitoring, Automation, Data acquisition, Water management, Equipment, Data processing, *Severn-Trent Water Authority, England.

In the Severn-Trent Water Authority a selection of commercial monitors is used together with specialist in-house developed monitors to help give a comprehensive water quality picture. Monitoring statins are expected to fulfill the two roles of sounding an alarm in the event of a polution problem and gathering historical quality data at that site. The procedure used to minimize false call-outs is briefly reviewed. The automatic data acquisition system is described, including data logger operations, and data recovery. Sensor technology has not as yet developed sufficiently to enable an automatic monitoring system to measure determinands which are most desirable, or if this is possible, costs are frequently prohibitive, particularly if a number of stations are required. At present, monitoring stations frequently measure determinands which may hint at undesirable contaminatino, but do not allow this to be quantified or identified unequivocally. Current sensors and sampling systems have a significant failure rate; consequently a limited proportion of erroneous results should be expected and dealt with accordingly. (Baker-FRC)
W82-04592

AUTOMATIC COLLECTION AND TRANSMISSION OF DATA FOR THE FEDERAL WATERWAY AUTHORITY.
Bundesanstalt fuer Gewasserkunde, Coblenz (Germany, F.R.).
F. Gunneberg.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 1 Fig, 1 Tab.

Descriptors: *Automation, *Data transmission, *Data acquisition, Water quality data, On-site data collections, Hydrologic data, Flood data, Water level, Rivers, Germany, Remote control, Computers.

The West German Federal Waterway Authority is installing remote control equipment at its gauging and water quality monitoring stations in order to save labor costs and provide instantaneous access to water level data for flood prediction and pollution monitoring. Transmission is via the authority's own telephone lines. On-site storage of data for several days is provided in case of service interruption. Check channels are provided. Analog data from temperature, conductivity, acidity, and other sensors are transformed by an analog-digital converter, whereas water level data are obtained in digital form by coupling an optical encoder to the standard gauging facility. A quartz clock controlled microprocessor calls up gauging data every full minute, averages the data every 15 minutes, and stores the value in solid state memory. This procedure smooths the ripple caused by passing ships. Up to 22 sensors can be connected to one field station. The microprocessor is restarted every

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day at midnight in order to protect against program execution breakdown due to power failures and the like. Maintenance personnel visiting the field station can plug in a liquid crystal display to read out the last values registered and the clock setting. Additional facilities are provided on regulated rivers. (Carroll-FRC)
W82-04596

DATA ACQUISITION FOR RIVER MANAGEMENT,
Thames Water Authority, Berkshire (England).
C. A. Hanson.
Water Science and Technology, Vol 13, No 11/12, p 687-692, 1981. 2 Ref.

Descriptors: *Water management, *Data acquisition, Computers, Monitoring, Automation, Rivers, *Thames River, River Lea, Catchment areas, *River systems, River management.

The requirements for data and information to manage and control a river system go beyond those for single process control. These requirements are discussed along with the philosophy of operation for the Thames Water data acquisition and control system for river management. This system has been operational since 1979. The system covers the catchments of the freshwater Thames above Teddington Lock and the River Lea, a major catchment which discharges directly to the tidal Thames and whose lower reaches pass through the outer conurbation of north east London. Both rivers have a navigational function. One of the additional requirements in river management beyond water supply and sewage treatment functions is for continuous time-series data as a prerequisite of system understanding before any meaningful control objectives can be established. Catchment data is also required to make projections for planning purposes. In river management data acquisition must be commenced in anticipation of problems to be met years ahead, and the quality of the data should assume decreasing margins of error and improving modelling techniques able to take advantage of the data quality. The first stage of the Thames Water data acquisition system consisted of a radio communications network, a computer control system and 67 field stations. Most of the difficulties encountered in commissioning the system revolved around the computer. At present attempts are underway to integrate the system of data from a precipitation radar station into the overall scheme. (Baker-FRC)
W82-04601

7B. Data Acquisition

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,
Ohio State Univ. Columbus. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 2B.
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 2B.
W82-04265

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
E. M. Swenson.
Estuaries, Vol 4, No 3, p 161-166, 1981. 7 Fig, 17 Ref.

Descriptors: *Estuarine environment, *Tidal rivers, Electromagnetic waves, *Tidal range, *Measuring instruments, Monitoring, Flow, Flow measurement, Tidal flow.

An electromagnetic method for monitoring tidal flow, inexpensive and relatively maintenance free after deployment, is presented. This provides a possible alternative transport measurement system for understanding tidal transports. Comparison of the electric potential signal to transports determined from current meter records is used to calibrate the system. The method depends on the measurement of the electric potential produced across a tidal channel by tidal currents. The induced potential is proportional to the vector cross product of the magnetic field of the earth and the water velocity. A volume flow of 100 cubic meters per second will induce a potential near 1 mV. Examples are given of measurements taken at Great Bay, New Hampshire and Lake Pontchartrain, Louisiana. These examples illustrate the observation that the method is capable of yielding volume flow measurements with an uncertainty of about 15%. The method does have some limitations due to salinity and temperature changes, calibration drift, and lack of definition of the spatial characteristics of the flow. (Baker-FRC)
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,
North Carolina State Univ. at Raleign. Dept. of Zoology.
R. G. Hodson, C. R. Bennett, and R. J. Monroe.
Estuaries, Vol 4, No 3, p 176-184, 1981. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Sampling, *Estuarine environment, *Plankton, Fish, Biomass, *Measuring instruments, Bottom sampling, Sampling devices.

The construction and use of some new and modified ichthyoplankton sampling devices are described. These devices can be operated from small, relatively fast boats in shallow estuarine waters using nets up to 1 meter in diameter. The gear uses one meter diameter nets on square and rectangular frames and provides simultaneous surface and bottom samples. The equipment provides quantitative and qualitative ichthyoplankton samples from shallow estuarine waters 1 to 12 meters deep. Filtration performance in relation to clogging of 505 micron mesh nets averaged 97% and 103% for the surface and bottom nets respectively. These high filtration rates were attributed to the design of the net frames, which apparently act as mouth reducing cones. Catch data for several species from the side-by-side and separated rigs were analyzed with a nested model of analysis of variance. No systematic error was noted to be inherent in the design of the two samplers, which precluded direct comparison of surface and bottom samples taken with them. (Baker-FRC)
W82-04297

MEASUREMENT OF AIR IN FLOWING WATER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
A. F. Babb, and H. C. Aus.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1615-1630, December, 1981. 16 Fig, 6 Ref.

Descriptors: *Bubbles, *Air entrainment, *Flow characteristics, Anemometers, Hydraulics, Water flow, Spillways, Flow velocity, Hot-film anemometer, Duration factor, Hydraulic engineering.

Air void fraction and bubble size were measured by the hot-film anemometer method, modified by a gamma-ray attenuation technique for calibrating the duration factor for the hot-film procedure. The duration factor, a function of velocity, varied from 1.5 msec for a velocity of 0.5 m per sec to 0.5 msec for 3.5 m per sec. Errors produced by computer identification of a nonexistent bubble and failure to detect the end of the bubbles were minimized by concurrent display of the anemometer signal and a computer signal indicating whether air or water was being detected. Minimum detectable bubble size was a function of the duration factor, and in turn, of velocity. Void ratio and bubble size were studied in a stable hydraulic jump maintained at a Froude number of 6. Larger bubbles, about 10 mm, were located near the upstream end of the jump. Larger bubbles were easily broken by turbulence, shear, and buoyancy. (Cassar-FRC)
W82-04322

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,
Alaska Univ., Fairbanks. Geophysical Inst.
W. D. Harrison, and T. E. Osterkamp.
Water Resources Research, Vol 17, No 6, p 1731-1736, December, 1981. 5 Fig, 16 Ref.

Descriptors: *Soil water, *Sampling, *Sediment sampler, Interstitial water, Permafrost, Sea ice, *Beaufort Sea Shelf, Alaska, Hydraulic conductivity, Water pressure, Temperature, Measurements, Water sampling.

An apparatus for obtaining interstitial soil water samples was applied in a study of sediments under the sea ice of the Beaufort Sea Shelf, Alaska. The portable, inexpensive sampler consists of a probe, metal shield, porous metal filter, and a check valve connected to the surface by plastic tubing inside a drill rod. It is designed for use in the saturated zone and works best in coarse-grained sediments difficult to sample by other methods. The water sample is removed with a bailer inside the tubing. It is not necessary to remove the probe between samples at different depths in the same hole. The apparatus may also be used to measure hydraulic conductivity, temperature, and water pressure. Special problems encountered in working with the permafrost sediments were: the interstitial soil water was partly frozen and only the liquid phase was collected, freezing in the tubing occurred occasionally, and bailers and sometimes tubing had to be warmed electrically before using. (Cassar-FRC)
W82-04325

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W82-04380

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALT-WATER INTERFACES IN COASTAL AQUIFERS.
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5A.
W82-04412

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, and W. B. Fowler.
Water Resources Bulletin, Vol 16, No 5, p 938-940, October, 1980. 2 Fig, 7 Ref.

Descriptors: *Snowmelt, *Measuring instruments, Lysimeter, Rainfall, Precipitation, Snow, Forest soils, Forest watersheds, Remote sensing, *Automation.

A technique is described for automatically recording the rate of snow melt at remote sites. The method can also be used for estimating liquid precipitation at the soil surface. The advantages of the method include the fact that water input to the forest floor is sampled directly and corrections for interception are not required; that windeffects on moisture deposition are completely avoided; that the system operates unattended for long periods of time; that the system is versatile in that the number and size of catch pans can be changed according to expected point to point variability in melt rates, and the size of the buckets can be changed; and the system can be adapted to a telemetering system for data transfer. (Baker-FRC)
W82-04435

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,
Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
K. E. Foster, R. A. Schowengerdt, and C. E. Glass.
Water Resources Bulleting, Vol 16, No 5, p 934-937, October, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Groundwater, *Remote sensing, *Landsat, Satellite technology, Water resources development, Water supply development, Water supply, *Arizona, Mapping, *Geohydrology.

A study was undertaken in 1978 to develop methods of exploring for water supplies based upon faulting detectable in satellite imagery. Northeastern Arizona was the site of the study. Control sites near Flagstaff and St. Johns were selected for more detailed investigation. The study was conducted in three phases. During Phase I lineaments ithin the entire study area were mapped using standard Landsat 1:250,000 scale, false color composites. Phase II, conducted simultaneously with Phase I, consisted of an inventory within the two study sites of well location, depth, land-surface altitude, yield, drawdown, specific capacity, and transmissivity. Four hydrologic parameters were chosen to correlate with lineament data: specific capacity, transmissivity, water temperature, and specific conductance. During Phase III a methodology was developed to correlate mapped lineaments with the hydrologic data. A well centered grid model was used in which the cumulative length of lineaments within a specified radial distance from each well was correlated with the four hydrologic parameters by use of linear regression. The correlations developed between lineament density and water data for the Flagstaff and Springerville well fields support the hypothesis that a relationship exists between regional geologic structure and well production. The study indicates that if there is a relationship between Landsat mapped lineaments and smaller fracturing in a given area, this two stage procedure can provide an efficient approach to groundwater exploration over large areas. (Baker-FRC)
W82-04436

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,
Science and Education Administration, Athens, GA.
R. B. Slack, and R. Welch.
Water Resources Bulletin, Vol 16, No 5, p 887-893, October, 1980. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Remote sensing, *Runoff forecasting, Hydrology, *Watersheds, *Mapping, Topographic mapping, *Landsat, Computers, Erosion, Soil conservation.

The possibility of deriving Soil Conservation Service (SCS) curve numbers for large watersheds from Landsat digital data is discussed. A curve number is a quantitative descriptor of the land cover/soil complex and is commonly assigned based on information gained from field surveys and interpretations of aerial photographs. The current study took place over the Little River watershed near Tifton, Georgia, an area of about 125 square miles. Landsat data was used to generate a classification map of this area with four hydrologically important classes: agricultural vegetation, forest, wetland, and bare ground. Missing soil data was interpolated from the vegetation patterns of the classification map. About half of the needed data was available from the Landsat experiment. A modification of the SCS curve table number was developed and used to assign each pixel to a category. The average curve number for each of six subwatersheds and for the entire watershed was then computed and compared with SCS values for the same areas. Agreement was to within two curve number units. The multitemporal aspect of Landsat permits the selection of image data at periods of the year when land cover and runoff considerations are critical to hydrologic studies. The digital format of Landsat data is compatible with the input requirements of hydrologic models. It appears feasible to combine in a data base the CN's for pixel or grid cell sized units with information on soils, precipitation, slope, aspect, vegetation, and land use. Such an approach would permit refinement of hydrologic models. (Baker-FRC)
W82-04438

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W82-04440

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W82-04460

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,
A. C. Demetracopoulos.
PhD Thesis, June, 1981. 280 p, 70 Fig, 7 Tab, 190 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25950.

Descriptors: *Water quality, *Flow system, *Hydrologic aspects, *Model studies, Dissolved oxygen, Water circulation, Ponds, Mass transfer, *Impoundments, River systems, *Mississippi River, Water movement, Temporal variation, Spatial variation, Flow analysis.

The physical processes governing water circulation and hydrologic mass transport, as well as some of the biochemical processes determining the oxygen characteristics of shallow river impoundments are studied. Flow analysis is performed for an interconnected system of channels and for quasi-steady state conditions. The bulk flow is examined and interest is focused on the dynamic behavior of the flow. The response time of the aquatic system to changing wind conditions is examined in a simplified unsteady flow analysis. The study is extended to the water quality of shallow run-of-the-river impoundments. The main quality parameters are dissolved oxygen and algal biomass, The formulation and incorporation of the source and sink terms are addressed in the study. The validity of the combined hydrodynamic/transport/water quality model is checked against field measurements obtained in Pool 2 of the Mississippi River. The results are reasonable and show the significance of several interacting processes on dissolved materials and in particular dissolved oxygen very clearly. The model predicts concentrations of a dissolved conservative tracer or material, of dissolved oxygen, chlorophyll-a and water temperature. It is particularly suitable for low flow summer conditions when wind effects become significant or dominant and water quality exhibits strong temporal and spatial variations. (Sinha-OEIS)
W82-04482

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,
Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
V. Plate.
Water Science and Technology, Vol 13, No 11/12, p 671-676, 1981. 1 Fig, 1 Ref.

Descriptors: *Water quality, *Monitoring, Flood protection, *Automation, *Data transmission, Data acquisition, *Germany, Lower Saxony, Networks, Costs, Water level, Water resources management.

A network of 36 automatic monitoring stations is being developed in Lower Saxony in accordance with the reorganization of the water quality surveillance system now being undertaken. This network will be connected with a surveillance center in Hildesheim. The monitoring system will offer continuous observation of the water quality, allow for early recognition and announcement of deterioration or dangerous situations, and provide basic documentation for the purposes of studying water resources policies and management. The system will be completed by 1985. Principles, tasks and aims of the surveillance system as well as technical equipment of the monitoring stations, methods of data acquisition and tramsmission and the organization of the surveillance center in Hildesheim are described. Some timing and cost information is presented. About 30 of the most important water level gauge stations will be equipped with instrumentation appropriate for digital acquisition of water level measurement values and remote data transmission, especially for the purpose of flood protection. (Baker-FRC)
W82-04575

MANUAL GROUNDWATER SAMPLING DEVICE (VORRICHTUNG ZUR MANUELLEN WASSERPROBENENTNAHME AUS GRUNDWASSERMESSSTELLEN),
Forschungszentrum Wassertechnik (German,D.R.).
V. Peukert.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 336, 1981, ! Fig. (No English summary).

Descriptors: *Groundwater, *Sampling, *Equipment, Automation, *Water quality, Water sampling, Dissolved oxygen, Germany.

The standard technique for groundwater quality analysis in the German Decocratic Republic requires that the collecting tube be flushed before the sample is collected, a procedure which was difficult to accomplish with existing sampling devices. A new device was developed which permits a representative groundwater sample to be collected, based on a vacuum principle. This principle requires a difference of less than 9 m in height between the groundwater level and the sampler. A converted automatic air pump creates a vacuum, maintained by means of a check valve, in the sampling line. Water is drawn up through the collecting tube. Once the collection vessel is filled, ambient pressure is restored by opening a three-way stopcock, and the water collected is either placed in the sampling bottle or discarded. A water volume at least equal to the volume of tubing between the water level and the filter area is pumped out and discarded. Then the sample is drawn off from just above the filter. Introduction of oxygen to the sample is prevented by keeping the system closed and filling the reservoir completely during sampling. The desired sample water volume is carefully pipetted from the reservoir into a sample bottle. (Carroll-FRC)
W82-04582

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
Water Science and Technology, Vol 13, No 11/12, p 631-637, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Automation, Computers, Data acquisition, Water management, *Finland, Networks, Turbidity, Dissolved oxygen, Rivers, Hydrogen ion concentration, Chloride, Kymyoki River, Kokemaenjokia, *Data transmission.

The Kymijoki River and Kokemaenjoki River monitoring network comprises five land-based river stations and a central commputing unit consisting of a PDP 11/35 computer located at the Helsinki office of the National Board of Waters. The system began service in September of 1977. Data transfer from the station occurs twice daily via leased public telephone lines and is initiated by the computer. Data can also be requested manually from a control terminal if the need arises. Every monitoring station measures temperature, pH, conductivity, dissolved oxygen, turbidity, and chloride level at five stations and redox potential at two of the stations. In seven sstations the measuring cham-

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ber also houses the built-in ultrasonic transducers for cleaning the sensors hourly, together with the drive motors needed for daily calibration and cleaning cycles. The quantity of the data gathered allows the use of statistical procedures for estimating the optimal sampling frequencies. (Baker-FRC)
W82-04585

RECENT DEVELOPMENTS IN AND APPLICATION OF AUTOMATION AND MONITORING IN WATER MANGEMENT,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden-, und Lufthygiene.
R. Leschber.
Water Science and Technology, Vol 13, No 11/12, p 715-719, 1981.

Descriptors: *Water management, *Reviews, *Monitoring, Automation, Water supply, *Water quality, Water quality control.

This communication briefly reviews the main subjects presented at the Congress and Exhibition 'Wasser Berlin '81' and the essential new ideas and results of research. The range of subjects covered at the conference included general reports on the present and future role of automation and related fields in water management as well as papers which dealt with telemetry and micro-processors. Monitoring of surface waters and other drinking water sources made up another group of subjects. The bulk of papers pertained to the subjects of water treatment and supply. The two most advanced systems operating in Switzerland were described, one of which operates without any technical staff and the other where staff can rely on the most conemporary aids of data processing. Data flow, data storage, and data retrieval in the form of periodic reports were described. In the fields of water treatment the major subjects were dosage of chemicals and monitoring of the success of the individual stages of treatment. Automation of sequences of procedures or complex methods of treatment was considered. The great advantage of using a computer with reserve capacity for specific raw water treatment was considered. Water supply was covered in papers dealing with general problems of the operation of municipal networks and a number of specific subjects. The various applications of servosystems for the operation of pumps and valves were described. (Baker-FRC)
W82-04593

STORM SEWER FLOW COMPUTATIONS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
K. Sivaloganathan.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 513-522, June, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Sewer systems, Lateral sewers, *Pipe flow, *Storm sewers, Hydraulics, *Flow characteristics, Hydrographs.

A new technique for dealing with storm sewer flows involving concentrated lateral inflows at junctions is described. Using St. Venant equations, each concentrated lateral inflow is replaced by a triangularly distributed lateral inflow over the adjoining few distance steps. The diffusing and the Lax- Wendroff methods were most suitable for solving the St. Venant equations with this technique. The implicit method of Strelkoff may be used if the equivalent triangular distribution of each concentrated lateral inflow is not done over too small a distance. Methods unsuitable for this technique were the rectangular grid broken characteristic scheme and the leap frog method. Depth hydrographs prepared from experimental and computed data were in good agreement. (Cassar-FRC)
W82-04640

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,
Lancaster Univ., Bailrigg (England).
D. M. Sargent.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 1-15, March, 1981. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Flow measurement, *Streamflow, *Bubbles, Integrating float method, Photography.

The integrating float method for measuring streamflow was modified by using air bubbles as rising floats. This method, first suggested a century ago, has never been practical because the buoyant floats in the stream were difficult to locate. A length of pipe was installed in a straight line across the river bottom. Air was forced through nozzles placed at intervals along the pipe to produce a line of rising air bubbles. Photographic equipment was set up on the bank to record the position of the air bubble line. Streamflow values obtained using the integrating float method in a medium-sized river were within -6 to +10% (average 1.3%) of streamflows measured by a weir. Errors were greatest at low and high flow. (Cassar-FRC)
W82-04643

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
P. C. Pandley, B. S. Gohil, and A. K. Sharma.
Mausam, Vol 32, No 1, p 17-22, January, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Meteorological data collection, Water vapor, Microwaves, Radiosondes, *India, Bay of Bengal, Arabian Sea, Satellite technology, Radiometry, *Bhaskara satellite.

Integrated abundances of water vapor and liquid water over oceans were determined from data obtained from the Indian satellite Bhaskara during its June 27, 28, and 29, 1979, orbits. Aboard the satellite is a microwave radiometer (SAMIR) with 19.35 GHz and 22.235 GHz channels. Values of water vapor and liquid water content, respectively, were: June 27 over the Arabian Sea, 4.0 g per sq cm and 0.5-0.7 kg per sq m; June 28 over the Bay of Bengal, 4.4-6.0 g per sq cm and 0.8-2.1 kg per sq m; and June 29, a tropical depression over the Bay of Bengal, 3.6-4.7 g per sq cm and 1.7-1.9 kg per sq m. Although no accurate data were available for comparison, the findings were in general agreement with mean monthly precipitable water radiosonde data from coastal stations and from APT pictures. (Cassar-FRC)
W82-04647

COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER,
Geological Survey, Lakewood, CO.
H. H. Stevens, Jr., G. A. Lutz, and D. W. Hubbell.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 608-611, April, 1980. 2 Fig, 5 Ref.

Descriptors: Water sampling, *Suspended sediments, Rivers, Estuaries, Measuring instruments, *Sediment sampler.

The U. S. Federal Interagency Sedimentation Committee has developed special sampling techniques and equipment to help ensure the collection of meaningful samples of the suspended-sediment load in rivers and estuaries. This paper describes a collapsible-bag sampler that is based on somewhat different operating principles than conventional U.S.-series samplers, but which has similar sampling characteristics and is used in the same manner as those samplers. This collapsible bag sampler facilitates the collection of samples from large rivers and estuaries because it permits the continuous collection of representative depth-integrated samples of water-sediment mixture in all water depths and velocity distributions and the convenient and quick collection of large volume samples. In addition, the maximum depth capacity of the sampler can be readily changed by altering the internal diameter of the nozzle or the volume of the sample bag. The nozzle of the container can easily be fitted with an off-on valve to permit the sampler to be used as a point-integrating sampler. The sampler is easy to use and to maintain, even in salt water. Various potential improvements in the sampler are also identified. (Carroll-FRC)
W82-04745

7C. Evaluation, Processing and Publication

WATERSHEDS AS THE BASIC ECOSYSTEMS: THIS CONCEPTUAL FRAMEWORK PROVIDES A BASIS FOR A NATURAL CLASSIFICATION SYSTEM,
Corvallis Environmental Research Lab., OR.
F. B. Lotspeich.
Water Resources Bulletin, Vol 16, No 4, p 581-586, August, 1980. 1 Fig, 27 Ref.

Descriptors: *Watersheds, *Ecosystems, *Stream classification, Classification, Climate, Geology, Soil, Vegetation.

A classification scheme for watersheds, based on the ecosystem concept, is outlined. Climate and geology are selected as the state factors. These two factors interact to produce a land form and in turn an ecosystem. Climate is considered the master factor, having overwhelming influence on all ecosystem features. Possible classes of climate can be based on size, the concept of equivalent latitude, or the isophane concept (lines of equal biological activity as a function of temperature, which is in turn a function of latitude and elevation). Geology classifications may consider bedrock. Transactional factors are soil and vegetation, which interact with climatic and geologic factors to form a variety of tesseras. The stream, at the bottom of the scale, is passive and does not interact with the higher factors in the ecosystem. The stream is a result of interactions of all the forces on the two higher levels. (Cassar-FRC)
W82-04253

DECISIONS UNDER VIOLATION OF REGRESSION NORMALITY,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
E. Castano, L. Duckstein, and J. Weber.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 549-561, October, 1981. 1 Tab, 5 Fig, 35 Ref.

Descriptors: *Mathematical models, *Statistical analysis, *Management planning, Decision making, *Regression analysis, *Hydrology, Prediction, Engineering, Monte Carlo methods, Simulation, Distribution.

The accuracy of hydrologic predictions based on regression analysis under the incorrect assumption of normality is investigated. Monte carlo simulation is used to investigate the small sample behavior of the estimated regression coefficients, estimated variances, and predicted values of the dependent variable when the errors are not normally distributed. The distributions simulated are lognormal, Pearson, and LogPearson with varying degrees of skew. The estimated values of the regression coefficients are not appreciably affected by skew of the error distribution. Decisions based on both the mean and variance are less robust to nonnormality than decisions based only on the mean. For example, whenever hydrologic decisions are based on a percentile, as in T-year floods, or on a confidence interval statement in regression analysis, as in flood plain zoning, standard deviations are involved, so that results may be sensitive to violation of the normality assumption. (Titus-FRC)
W82-04264

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
J. H. W. Lee, and G. H. Jirka.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY12, p 1651-1675, December, 1981. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Cooling water, *Mixing, *Thermal pollution, Dilution, Powerplants, Tracers, Dyes, Shallow water, Jets, Water pollution control, Buoyancy, Fate of pollutants, Hydraulics, Flow characteristics, Turbulent flow.

The stability and mixing characteristics of a round turbulent buoyant jet discharging vertically into a stagnant water body of large horizontal extent were investigated analytically and experimentally to determine the aquatic impact of thermal effluents. In the case of a stable discharge configuration, four flow regimes can be distinguishd: (1) initial buoyant jet region, where the discharge mixes with the ambient fluid by turbulent entrainment, (2) surface impingement region, where the buoyant mixed flow is turned into a radially outward moving supercritical flow, (3) radial internal hydraulic jump region, transferring the flow into a subcritical region downstream with loss of energy, and (4) stratified counterflow region, with negligible entrainment across the surface. These 4 regions are analyzed separately and the solutions combined to predict the stability criteria. A laboratory half jet and dye were used to observe flows under different conditions. Jet diameters varied from 1.0 to 0.25 inches; discharge velocities, 0.82 to 30.0 ft per sec; discharge excess temperatures, 21.4 to 34.8 F; initial ambient temperatures, 70.2 to 79.1 F; discharge flows, 0.31 to 3.20 gal per min; Froude numbers, 8.0 to 583.4; and Reynolds numbers, 6800 to 62,500. Stability or nonstability and near field dilution were noted. This study indicates that shallow site conditions limit the dilution possible with single port discharges. Alternative designs include moving the outfall to greater depths or using a multiport diffuser. (Cassar-FRC)
W82-04365

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,
Geological Survey, Tucson, AZ. Water Resources Div.
H. W. Sanger, and G. R. Littin.
Geological Survey Open-File Report 82-87 (WRI), November, 1981. 2 Sheets, 16 Ref.

Descriptors: *Maps, *Groundwater, *Aquifer characteristics, *Water quality, Water level, Wells, Springs, Specific conductivity, Fluoride, *Arizona, Mohave County, Yavapai County, Yuma County, Bill Williams River.

The Bill Williams area includes about 3,200 square miles in west-central Arizona. Most water used is from ground water, although a small amount of surface water also may be diverted. About 18,000 acre-feet of ground water was withdrawn in 1979. The main water-bearing unit is the basin-fill deposits, which consist of boulder to pebble conglomerate and interbedded coarse- to fine-grained sandstone, siltstone, mudstone, and in places rhyolitic and basaltic tuff. Depth to water, altitude of the water level, well depth, and specific conductance and fluoride concentration are shown on the 1:125,000-scale map of the area. (USGS)
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,
Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds.
Geological Survey Open-File Report 81-1114, September, 1981. 52 p, 5 Fig, 16 Tab, 18 Ref.

Descriptors: *Groundwater, *Groundwater level, *Hydrologic data, *Aquifers, Potentiometric level, Observation wells, Well hydrographs, Water measurement, Groundwater availability, *Arkansas, Sparta Sand.

This report contains about 600 ground-water level measurements made in observation wells in Arkansas in the spring of 1981. In addition, the report contains potentiometric surface maps and well hydrographs relating to the alluvial aquifer and the Sparta Sand, the most important aquifers with respect to groundwater availability and use in Arkansas. (USGS)
W82-04489

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer.
Available from Nevada Bureau of Mines and Geology, Univ. of Nevada, Reno, Nevada 89557, Price: $2.50. Nevada Bureau of Mines and Geology Map 3A1, 1981. 1 Sheet.

Descriptors: *Maps, *Floods, *Detritus, *Hazards, Flood peak, Flood plains, Flood flow, Erosion, Deposition, *Nevada, *Las Vegas SE quadrangle.

This map shows flood and debris hazards on the Las Vegas SE quadrangle, Nevada. Estimates of the 100-year flood peak were made and the corresponding flood plains were outlined on the map for the principal drainages in the area. Degrees of hazard were assigned to the entire quadrangle on the basis of floodflows and potential debris movement. (USGS)
W82-04490

THICKNESS, PERCENT SAND, AND CONFIGURATION OF SHALLOW HYDROGEOLOGIC UNITS IN THE POWDER RIVER BASIN, MONTANA AND WYOMING,
Geological Survey, Billings, MT. Water Resources Div.
B. D. Lewis, and W. R. Hotchkiss.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $12.50. Geological Survey Miscellaneous Investigations Map I-1317, 1981. 6 Sheets, 23 Ref.

Descriptors: *Maps, *Geohydrology, *Geohydrologic units, *Aquifer characteristics, Hydrologic data, Geology, Geological surveys, *Montana, *Wyoming, Powder River basin.

The shallow hydrogeologic system is composed of five distinct units, bounded at its base by the regionally widespread and relatively impermeable Bearpaw Shale. The units, which were in age from Late Cretaceous to Holocene, are in ascending order the Fox Hills-lower Hell Creek aquifer, upper Hell Creek confining layer, Tullock aquifer, Lebo confining layer, and Tongue River-Wasatch aquifer. Shallow hydrogeologic units mapped in the Powder River basin of Montana and Wyoming are of marine and continental origin. The Fox Hills Sandstone is a marine deposit with all overlying units representing continental conditions. Thick and extensive coal deposits are present in the Tongue River Member of the Fort Union Formation and the Wasatch Formation. Geologic and hydrogeologic data were used to separate the various units into a system of alternating aquifers anf confining layers. Physical characteristics used to describe the units were thickness, percent sand, and configuration of the base of each hydrogeologic unit. (USGS)
W82-04501

DISSOLVED-SOLIDS CONCENTRATIONS OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $3.00. Geological Survey Hydrologic Investigations Atlas HA-645, 1982. 1 Sheet, 1 Tab, 14 Ref.

Descriptors: *Maps, *Dissolved solids, *Groundwater, *Water quality, Wells, Irrigation, Domestic water, Water analysis, Chemical analysis, Geohydrology, *California, *Sacramento Valley.

The general quality of the ground water in the Sacramento Valley, Calif., in terms of dissolved-solids concentration is considered good for irrigation, domestic, and most other uses. This map shows the distribution of dissolved-solids concentrations and is based on about 1,330 chemical analyses collected from about 900 wells between 1974 and 1978. On the west side of the valley some of the smaller streams contribute water of higher dissolved-solids concentrations to the ground water. The sources of these waters are thought to be the upper Cretaceous Chico Formation or marine deposits of Early Cretaceous age that are exposed in the Coast Ranges. (USGS)
W82-04502

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1980.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190380, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report AR-80-1, 1981. 585 p, 5 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Arkansas.

Water resources data for the 1980 water year for Arkansas consist of records of stage, discharge, and water quality of streams; and stage, contents, and water quality of lakes and reservoirs. This report contains discharge records for 60 gaging stations; stage and contents for four lakes and reservoirs; water quality for 152 stations, 69 partial-record flow stations, and eight lakes; and water levels for 79 observation wells. Also included are 116 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Arkansas. (USGS)
W82-04503

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
D. R. Scully, A. P. Krumhardt, and D. R. Kernodle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168402, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-56, 1981. 71 p, 37 Fig, 17 Tab, 31 Ref.

Descriptors: *Surface water, *Water quality, *Hydrologic data, *Coal mines, Streams, Flow characteristics, *Alaska, Beluga coal area, Peters Creek coal area, Healy coal area.

The Beluga, Peters Creek, and Healy coal areas in Alaska were studied during 1975-1978, with major emphasis on surface-water hydrology and water quality. In the Beluga coal area, mean annual discharge is estimated to range from 2.2 to 3.4 cubic feet per second per square mile of drainage area. The 7-day low flow with a 10-year recurrence interval is estimated to be 0.3 to 0.6 cubic feet per second per square mile. The surface waters are calcium bicarbonate type; have low concentrations of nutrients; and, at times, may contain dissolved iron and manganese in concentrations in excess of U.S. Environmental Protection Agency recommended limits. The pooled diversity index of the benthic invertebrate community ranges from 2.93 to 4.06. No ground-water wells have been drilled in the potential mining areas. Water quality of streams in the Peters Creek coal area is similar to that of the streams in the Beluga coal area. No attempt is made to define streamflow characteristics in the Peters Creek coal area due to poor correlations with nearby gaging stations. In the Healy coal area, streamflow characteristics are dissimilar between the two major basins studied. Lig-

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nite Creek is estimated to have less yield than Healy Creek. Studied tributaries of Healy and Lignite Creeks contain waters with a dissolved solids range of 111 to 636 milligrams per liter and have calcium and bicarbonate or magnesium and bicarbonate as principal ions. Iron and manganese concentrations are high at some times of the year. The concentrations of sodium and chloride increases significantly in the lower reaches of Lignite Creek. (USGS)
W82-04504

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,
Geological Survey, Orlando, FL. Water Resources Div.
A. S. Navoy.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $2.50, Microfiche $0.50. Geological Survey Open-File Report 81-1198, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Pumping, Geohydrology, *Florida, Sumter County.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Fla., for May 1981. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the low water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west central area. (USGS)
W82-04507

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEAR 1979 AND 1980,
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. McGovern, and L. J. Combs.
Geological Survey Open-File Report 81-348 (WRI), March, 1981. 107 p, 9 Fig, 5 Tab.

Descriptors: *Available water, *Water quality, *Groundwater, *Surface water, Water resources development, Water management, Aquifers, Selective withdrawal, Irrigation, Water use, Water supply, Streamflow, Runoff, Sediment transport, Flood frequency, Urbanization, Data collections, Publications, *Kansas, *Projects.

Activities of the U.S. Geological Survey in Kansas include the systematic collection and analysis of data to describe the framework of hydrologic systems, assess the water resources, define existing or potential problems in the quantity or quality of water, and provide information for optimum development and management of resources. Streamflow studies are made to determine availability of supplies and relations to rainfall runoff, urbanization, flood frequencies, and sediment-transport. Groundwater studies are made to determine the quantity of supplies available in aquifer systems, the effects of natural or artificial contamination, and the effects of withdrawals by irrigation, industrial, and municipal supplies. Water-quality studies are made to define physical, chemical, and biological characteristics in streams and principal aquifers, and to evaluate the chemical changes due to urbanization and surface mining. (USGS)
W82-04510

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter.
Geological Survey Open-File Report 80-1008 (WRI), 1980. 20 p, 5 Fig, 4 Plates, 10 Tab, 7 Ref.

Descriptors: *Groundwater, *Water table, *Observation wells, *Water level fluctuations, Sites, Maps, Estimating, Massachusetts, *Cape Cod.

Water-level records from 146 short-term (1 year) observation wells and 13 long-term (16-28 years) observation wells were used to estimate the probable high ground-water level that could occur at any site on Cape Cod. The estimation was based on correlation of a single water-level measurement from a test site with water-level records of the nine index wells. Maps showing areas of Cape Cod represented by the nine index wells and showing five ranges of water-level fluctuation are used in conjunction with tables of water-level adjustments to make the estimates. (USGS)
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. Gogel.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $20.00, Microfiche $3.50. Geological Survey Open-File Report 81-1112, 1981. 155 p, 54 Fig, 16 Tab, 3 Ref, 2 Append.

Descriptors: *Hydrologic data, *Aquifer characteristics, *Structural geology, *Cores, Test wells, Hydraulics, Water quality, Water analysis, Hydraulic conductivity, Logging(Recording), Geochemistry, *Kansas, Arbuckle Group, Miami County, Douglas County, Saline County, Labette County.

Preliminary data are presented for test wells in Kansas that were completed in Cambrian and Ordovician rocks of the Arbuckle Group in late 1979 and early 1980. Included in the report are hole history, electrical logs, geology (sample descriptions and cores), hydrologic testing, and geochemistry. These wells were drilled to determine the regional hydrology of the Arbuckle Group and to investigate the hydraulic characteristics of the formation at site-specific areas. The test wells were drilled in Miami, Douglas, Saline, and Labette Counties, Kansas. Depths of the wells ranged from 1,816 feet in Labette County to 3,665 feet in Saline County. Results of core analyses from rocks in the Arbuckle Group are presented for vertical and horizontal permeability to air, porosity, fluid saturation, acoustic velocity, resistivity indices, and formation factor. Formation data from drill-stem tests are presented for use in calculating transmissivity, hydraulic conductivity, and hydraulic head. Analyses of water samples from the test wells are presented to indicate water quality in the aquifers. (USGS)
W82-04512

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $10.75, Microfiche $3.50. Geological Survey Open-File Report 81-821, 1981. 77 p, 6 Fig, 37 Tab, 1 Ref.

Descriptors: *Water quality, *Data collections, *Surface water, *Groundwater, Canals, Marshes, Bottom sampling, Water analysis, Nutrients, Trace elements, Algae, *Florida, Dade County, *Everglades.

The results of water-quality samples collected from April 1978 through April 1980 from three canal stations, four marsh stations, and two ground-water stations within the East Everglades, Dade County, Florida, are tabulated in 37 tables. The major categories of parameters analyzed are field measurements, physical characteristics, macronutrients (carbon, nitrogen, and phosphorus), major ions, trace elements, and algae. Chemical data for bulk-precipitation stations within and adjacent to the East Everglades are also given. The parameters analyzed include macronutrients, major ions, and trace elements. The period of record for these stations is October 1977 through April 1980. Bottom material at the canal and marsh stations was collected twice during the investigation. These data include analyses for macronutrients, trace elements, and chlorinated-hydrocarbon insecticides. (USGS)
W82-04513

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,
Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo, and L. M. Voronin.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $9.00, Microfiche $4.50. Geological Survey Open-File Report 81-814, May, 1981. 38 p, 1 Fig, 2 Plates, 6 Tab, 19 Ref.

Descriptors: *Water quality, *Groundwater, *Data collections, Unconsolidated aquifers, Aquifer characteristics, Sampling, Chemical analysis, Wells, Well data, Inorganic compounds, Organic compounds, *Water analysis, Coastal plains, *New Jersey, Potomax-Raritan-Magothy aquifer system, Pennsylvania.

Samples for chemical analysis were collected from June to December 1980 from 262 wells tapping the Potomac-Raritan-Magothy aquifer system. The samples were analyzed for common ions, dissolved metals, nutrients, dissolved organic carbon, volatile organic compounds, pH, temperature, and specific conductance. This report contains the results of the analyses, well construction data for the wells sampled, and simple statistical summaries for each parameter. Most parameters showed wide variations in concentration. Concentrations of dissolved organic carbon ranged from 0 to 108 mg/L (milligrams per liter), with a median of 1.7 mg/L. Chloride concentration ranged from 0.8 to 810 mg/L, with a median of 15 mg/L. Iron concentration ranged from 3 micrograms per liter to 79,000 micrograms per liter, with a median of 1,400 micrograms per liter. Detectable concentrations of volatile organic compounds were found in 46 wells, approximately 19 percent of the 246 wells sampled for such compounds. Trichloroethylene and benzene, the most common compounds, were detected in 24 and 18 wells, respectively. The maximum concentrations of several compounds detected include: benzene, 1,960 micrograms per liter; 1,1-dichloroethylene, 670 micrograms per liter; trichloroethylene, 472 micrograms per liter; and tetrachloroethylene, 335 micrograms per liter. (USGS)
W82-04515

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,
Geological Survey, Towson, MD. Water Resources Div.
W. W. Staubitz.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.

Descriptors: *Water quality, *Strip mines, *Streamflow, *Data collections, Monitoring, Networks, Surface water, Sediment discharge, Coal mining, Water analysis, Benthic fauna, Base flow, *Eastern Coal Province, Area 5, Area 6, North Branch Potomac River, Youghiogheny River, Casselman River, Maryland, Pennsylvania, West Virginia.

The U.S. Geological Survey is monitoring the water quality of streams within the Eastern Coal Province. This report contains streamflow, water-quality, and biological data collected in the North Branch Potomac River basin and in the Maryland portion of the Youghiogheny and Casselman River basins. Data collected from 64 streams from April 1979 to June 1980 are presented in tables. Other sources of hydrologic information within the study area are also described in the report. (USGS)
W82-04516

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-04517

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142902, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-33, May, 1981. 297 p, 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Water supply, *Irrigation, *Surface water, *Data collections, *Water quality, Water analysis, Trace elements, Hardness, Water use, *Oklahoma, Arkansas River, Verdigris River basin, Neosho River basin, Illinois River basin.

Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illinois River basins within Oklahoma were examined for water type and suitability for public water supply and irrigation use. The classification of water type was based on the relation of the major ions: calcium, magnesium, sodium, bicarbonate/carbonate, sulfate, and chloride to each other within the range of measured specific conductance. The judgement of suitability for public supply use was based on the concentration levels and distributions of selected constituents. The Wilcox irrigation classification scheme was used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of phytotoxic effects from boron was discussed where data were available. (USGS)
W82-04518

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190372, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-1, 1981. 341 p, 8 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, *Delaware River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams, elevation and contents of lakes and reservoirs, and water levels of groundwater wells. This volume contains records for water discharge at 73 gaging stations, elevation and contents at 11 lakes and reservoirs, water quality at 39 gaging stations, and water levels at 16 observation wells. Also included are data for 43 crest-stage 28 low-flow, and 43 water-quality partial-record stations. Locations of these sites are shown on figures 4 through 7. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-04521

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1980. APPENDIX - COAL AREAS.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-159674, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-80-A, October, 1981. 228 p, 9 Fig, 8 Tab.

Descriptors: *Coal, *Hydrologic data, *Surface water, *Water quality, Streamflow, Flow rates, Sediments, Water analysis, Water temperature, Chemical analysis, Coal mines, Data collections, Sites, *West Virginia, Coal areas.

Water resources data for the 1980 water year for coal regions of West Virginia consist of discharge and water-quality records collected during two sampling periods at 369 sites. Also included are sediment data from 26 sites. Data were collected as a part of the statewide Coal Hydrology project. (USGS)
W82-04522

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1981--VOLUME 3. COASTAL LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129305, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report LA-81-3, 1981. 218 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, *Coastal Louisiana.

Water resources data for the 1981 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage for 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-04523

8. ENGINEERING WORKS

8A. Structures

RIDING MILL PUMPING STATION,
D. J. Banks, D. F. H. Pain, and W. Banks.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 463-482, 1981. 7 Fig, 6 Ref.

Descriptors: *Water conveyance, *Construction, Design criteria, Maintenance, Pumps, *Water supply systems, Kielder Water Scheme, Pumping plants, River Tyne, River Wear, River Trees, *England, Water transfer, Pipelines, Water demand.

The large pumping capacity, intermittent usage, and large size of the Riding Mill pumping station have demanded reconsideration of usual water supply practices. The operating concepts, design development, and plant selection are described for this plant, which is part of the Kielder Water Scheme and is designed for bulk transfer of water from the River Tyne to the Rivers Wear and Trees. Tyne water is relatively unpolluted, with virtually no suspended solids. Therefore it was possible to use single-stage pumping and thus avoid the major costs of low-lift pumps and large settling tanks. Debris and sediment intake problems was reduced by arranging the draw-off to avoid obstruction to river flow and keeping the draw-off sill above river bed level and the intake velocity as low as possible. Fine mesh band screens were placed in a chamber back from the river frontage to protect the pumps and exclude smolts. Trash bars were selected rather than penstock openings. The pumping station was designed for unattended automatic operation. A special pipeline filling pump was installed. (Baker-FRC)
W82-04292

APPROXIMATE SIZING OF RESERVOIRS FOR DETENTION TIME,
Commonwealth Tech, Inc., Lexington, KY.
J. S. Tapp, A. D. Ward, and B. J. Barfield.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 17-23, January, 1982. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Detention times, *Reservoir design, *Sedimentation basins, Design criteria, *Sediment control, Spillways, Hydrographs, Storms, Rainfall, Reservoir storage.

Design of sediment control reservoirs has been facilitated by a new procedure using triangular hydroraphs to give a first approximation of the peak outflow and storage volume necessary to give a desired detention time. Only 1 or 2 trials are necessary. The size of the spillway system and the sediment pond design may be hand calculated for a given detention time. The triangles approximate the inflow-outflow hydrographs. This method was compared with the detailed computer model DEPOSITS. After modifications in the equations, the standard error was an acceptable 0.028 watershed in. The procedure is applicable to reservoirs with principal spillway crests located at the top of the sediment storage pool. (Cassar-FRC)
W82-04315

MICRO HYDROPOWER IN THE USA,
EG and G Idaho, Inc., Idaho Falls.
R. O. Haroldsen, and F. B. Simpson.
International Water Power and Dam Construction, Vol 33, No 11, p 48-50, November, 1981. 1 Fig.

Descriptors: *Hydroelectric plants, *Powerplants, *Economic evaluation, Water resources development, Rural areas, Diesel units, Case studies.

Micro hydropower is not expected to make a major contribution to the nation's energy production. However, developers may gain a measure of independence and security, especially in isolated areas where small diesel units are used. Two plants are described. The 50 kW plant at Bliss, Idaho, produces $1000 per month of power from a $40,000 capital investment. A low head installation (effective head 2 m) at Aumsville, Oregon, produces a maximum 23 kW out of a design 40 kW. Many other problems make this site a poor investment, producing only $100-200 of power monthly. There is a need for reasonable standards to cover connections with the utility power grid and for better information on site assessment, equipment, institutional requirements, and available technology. (Cassar-FRC)
W82-04316

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,
Department of the Air Force, Washington, DC.
W. F. Rowell, and J. W. Barnes.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 137-148, January, 1982. 4 Fig, 17 Ref.

Descriptors: *Network design, Pipes, *Water distribution, Water quality control, *Model studies,

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Water demand, Water conveyance, Water mains, Design criteria, *Water supply systems.

A procedure to help with selecting a water distribution network layout involves two steps. The first step uses a nonlinear programming model to select an economical tree layout for the larger diameter pipe links to provide service under normal demand. The second step uses an integer programming model to choose loop-forming redundant links and corresponding link diameters to provide adequate capacity in case the large diameter primary link system fails. The second level system reduces water stagnation, retards sediment accumulation, facilitates pipe cleaning, and provides alternate paths. The procedure is illustrated using a two-source water distribution system. (Cassar-FRC)
W82-04319

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,
Hydro Watts Inc., Washington Grove, MD.
S. L. Bierman, and R. A. Klempner.
International Water Power and Dam Construction, Vol 33, No 11, p 35-36, November, 1981. 1 Tab.

Descriptors: *Hydroelectric plants, *Powerplants, *Dams, Hydraulic structures, *Cost analysis, Feasibility studies, Costs.

Incentives for private developers to invest small (less than 5 MW) hydropower schemes include rising fuel prices, governmental financial assistance, and the obligation of utilities to offer to buy output. There are 700 existing U.S. dams which are feasible to develop. Average head is 15 m; average flow, 10 cu m per sec; and average reservoir surface area, 2.4 million sq m. Development costs, which range up to $2000 per kW of installed capacity, are quipment, 33% of total costs; civil works. 40-50%; engineering and interest during construction, 10-15%; and contingency, 10%. Operating costs are variable and may be as high as 6 cents per kWh. (Cassar-FRC)
W82-04327

RURAL POWER SCHEMES IN PAKISTAN,
Peshawar Univ. (Pakistan). Dept. of Electrical Engineering.
M. Abdullah, and A. R. Inversin.
International Water Power and Dam Construction, Vol 33, No 11, p 23-25, November, 1981. 2 Fig.

Descriptors: *Rural areas, *Hydroelectric plants, *Pakistan, *Developing countries, Design criteria, Powerplants, Hydraulic structures, Dams.

In the mountainous remote regions of northern Pakistan there are 22 5-15 kW microhydropower schemes in operation. Costs per installed kilowatt are $250-400. These projects are built by villagers from local materials. No engineering drawings are provided. Technical assistance is given by the Appropriate Technology Development Organization, a government agency. A typical installation has an intake consisting of a low stone weir and unlined headrace. Penstocks, usually 5-15 m long, are made of steel pipe or oil drums. The cross-flow turbine is made locally from strips of steel or pieces of pipe. Generators, presently made in China, will be manufactured locally in the near future, saving about 25% in costs. The electricity is generally used for lighting and to run machines in cottage industries. (Cassar-FRC)
W82-04328

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,
A. T. Corey.
Transactions of the ASAE, Vol 24, No 6, p 1504-1507, November/December, 1981. 1 Fig, 3 Ref.

Descriptors: *Drainage systems, *Sumps, *Storage capacity, Design criteria, *Pumps, *Tile drainage, Subsurface drainage, Conduits.

The size and cost of storage capacity of sumps for pumped outlets of subsurface drainage systems can be reduced by using the disposal tile as part of the storage system. This is feasible where the tiles can be below the grade of the collector tiles so that submergence of the main drain does not block discharge from the laterals. The maximm discharge capacity of the disposal tile should be nearly that of the pump, or else the pump motor will cycle excessively when the tile is flowing nearly full. Equations and a method for designing necessary sump storage are given. (Cassar-FRC)
W82-04364

OPTIMAL DESIGN OF URBAN STORM WATER DRAINAGE SYSTEMS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. K. Robinson, and J. W. Labadie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211491, Price codes: A02 in paper copy, A01 in microfiche. In: Proceedings 1981 International Symposium on Urban Hydrology, Hydraulics, and Sdiment Control, July 27-30, 1981. University of Kentucky, Lexington. 12 p, 4 Fig, 6 Tab, 12 Ref. OWRT C-90037-U(0507)(1). 14-34-0001-0507.

Descriptors: *Urban drainage, *Storm sewers, Minimum cost, Storm sewer design, Dynamic programming, *Design criteria, *Costs, Systems analysis, Comparison studies.

Several researchers have developed screening models for minimizing the cost of sizing and vertical alignment of storm sewer systems. One of the disadvantages of these models is that they are designed with specific physical/economic assumptions in mind, as well as specific types of cost functions. These assumptions are effectively hardwird into the program, which militates against modifying the program to suit situations not covered in the original assumptions. A generalized dynamic programming computer code has been developed at Colorado State University called CSUDP. A library of subroutines is being prepared as an adjunct to the basic code for solving a wide range of civil engineering problems. One of the packages includes a set of subroutines for storm sewer design. The coding includes data management routines for convenience to the user not familiar with dynamic programming. The code can consider complex branching networks with up to three pipes entering a given manhole. Default options are available for excavation, pipe, and manhole cost functions. If the costs for a particular case have a significantly different structure, the user can supply his own subroutine. There are several other default options which make this program extremely convenient for normal design conditions, as well as usable for unique problems. Extensive comparisons have been made between available published results of other dynamic programming screening models and the CSUDP package. Results are extremely close. The one comparison resulting in a large deviation was due to slightly differing hydraulic and cost assumptions, which caused larger commercial pipe sizes to be chosen by CSUDP, even though actual pipe requirements deviated little.
W82-04414

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Turner, Collie and Braden, Inc., Houston, TX.
S. D. Fitzgerald, and E. R. Holley.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1179-1195, October, 1981. 5 Fig, 11 Ref. OWRT A-091-ILL.

Descriptors: *Pipe flow, *Jets, *Mixing, Optimization, Pipes, Uniform flow, Water currents, Pipelines.

The use of jet injections was evaluated to provide initial mixing and thereby hasten the mixing process between a miscible substance and water flowing in a piepline. The study experimentally investigated several jet injection systems to determine their mixing characteristics, identified those systems providing the most rapid mixing, determined optimum operating conditions, and investigated the effects which secondary currents had on the mixing. For uniform pipe flow with a given number and orientation of jets, the ratio of jet momentum flux to the pipe-flow momentum flux was the parameter indicative of the mixing induced by the jets. Under many circumstances, it may be practical to consider only a 90 deg angle of injection. Experiments also investigated two diametrically opposed 90 deg jets in uniform flow. Optimum mixing was obtained when the momentum ratio for each jet was on the order of one-half of the optimum momentum ratio for a single jet injection. Also, experiments on a pipe flow with an induced secondary current indicated that the use of two or more jets would provide a factor of safety against the effects of unknown secondary currents. (Small-FRC)
W82-04558

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),
Technische Univ., Dresden (German D.R.).
For primary bibliographic entry see Field 4A.
W82-04576

METHODS FOR ASSESSMENT OF STREAM-RELATED HAZARDS TO HIGHWAYS AND BRIDGES,
Colorado State Univ., Fort Collins. Engineering Research Center.
H. W. Shen, S. A. Schumm, J. D. Nelson, D. O. Doehring, and M. M. Skimmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219750, Price codes: A12 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-80/160, March, 1981. 252 p, 32 Fig, 3 Tab, 51 Ref, 4 Append. DOT-FH-11-9396.

Descriptors: *Bridge design, *Highways, *Hydraulic design, *Stream erosion, *Bank erosion, Sedimentation, Deposition, Bridge failure, Land use, Remote sensing, Slope stability, Stream banks, Avulsion, Aggradation, Meanders, Morphology, Scour, Waves, Flotsam.

River behavior at a highway crossing depends not only on the stability of that particular river reach, but also on the behavior of the entire fluvial system. A complete evaluation of hydraulic hazards cannot be solely based on on-site hydrologic, hydraulic and geomorphic factors; but must also include insight into historic trends, synoptic considerations of basin characteristics, and anticipation of future changes. Because determination of stream-related hazards is a complex task, it is beneficial to generalize relative stability based on stream type. Streams can be divided into five types based on channel pattern and mode of sediment deposition. Each stream type exhibits its own characteristic stability. After evaluating stream variables, a list of potential stream hazards can be developed. Stream-related hazards include: degradation and scour; nickpoint migration; bank erosion; aggradation and fill; downfilling and backfilling; berming; meander growth and shift; channel bars and islands; cutoffs; avulsion; river-metamorphosis; floating objects; waves and surges. Each potential hazard can be evaluated on an individual basis and properly considered in either the design of a new crossing or maintenance of an existing one. Numerous evaluation methods are available to hydraulic engineers that have not been fully utilized. Methods such as remote sensing, land use evaluation and slope stability analysis should not be overlooked. (Moore-SRC)
W82-04626

THE DESIGN OF ENCROACHMENTS ON FLOOD PLAINS USING RISK ANALYSIS,
Federal Highway Administration, Washington, DC. Office of Engineering.
M. L. Corry, J. S. Jones, and P. L. Thompson.
Hydraulic Engineering Circular No 17, October, 1980. 134 p, 15 Fig, 14 Tab, 23 Ref, 3 Append.

Descriptors: *Flood plains, *Bridge design, *Risks, *Highways, *Flood damage, *Cost analysis, Culverts, Scour, Channel erosion, Economic aspects,

Design criteria, Embankments, Dikes, Earthworks, Alternative planning.

The design of all flood plain encroachments should include an evaluation of the inherent flood related risks to the highway facility and to the surrounding property. When this evaluation indicates that the risk warrants additional study, a detailed analysis of alternative designs is necessary in order to determine that design with the least total expected cost (LTEC) to the public. An essential ingredient in the LTEC design concept is risk analysis. All quantifiable losses are included in the risk analysis. These may involve damage to structures, embankments, surrounding property, traffic related losses and scour or stream channel damage. The product of the risk analysis is the annual economic risk associated with each design strategy. The sum of the annual economic risk and the annual capital costs results in the total expected cost (TEC) for each design strategy. Comparison of the TEC's for all design strategies allows the designer to select the LTEC or optimum design. Although the emphasis in this manual is on bridge crossings, the LTEC decisionmaking process concept is applicable to other drainage features. For example, it may be utilized in the design evaluation of culverts, longitudinal encroachments, countermeasures and foundation elevations. (Moore-SRC)
W82-04631

APPLICATION OF THE SOUTHWELL PLOT METHOD TO THE INSPECTION AND TESTING OF BURIED FLEXIBLE PIPES,
Cambridge Univ. (England).
A. J. Valsangkar, A. M. Britto, and M. J. Gunn.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 63-82, March, 1981. 14 Fig, 5 Tab.

Descriptors: *Pipes, *Buckling, *Deformation, Nondestructive tests, Southwell plot, *Stress, Flexibility, Inspection, Safety, Soil mechanics, Soil strength, Pipelines, *Design criteria.

A nondestructive method for estimating the buckling load of buried flexible pipes uses the Southwell plot. It allows estimation of a generalized out-of-roundness and predicts a buckling load. The difference between predicted and actual buckling loads is greater at larger initial out-of-roundness values for the buried pipe. A method is presented for estimating the safe failure load from the Southwell plot buckling load and the generalized out-of-roundness. Experimental data produced by other investigators on the stability of buried pipes were used to test the validity of this method. Very flexible pipes (effective stiffness < 0.5 kN per sq m) in dense sand produce small deflections before failure and cannot be reliably analyzed by the Southwell plot method. Pipes with effective stiffness of 3.62-157.1 kN per sq m may be loaded to about two thirds of their buckling load, at which stage the Southwell plot is linear. (Cassar-FRC)
W82-04649

ADOPTING SEWERS,
Southern Water Authority (England).
J. Budleigh.
Water, No 42, p 20-21, 1982. 2 Ref.

Descriptors: *Sewer systems, *Design criteria, Management, *Construction, *Housing, Land development.

Traditionally sewers are constructed by the developers of housing projects and offered to the water authority for adoption when finished in much the same way as estate roads. The ground rules for adoption are laid down in Section 17 and 18 of the Public Health Act of 1936. Two alternative arrangements are offered to the developer. In Section 17 he may design and construct the sewers as he sees fit and then offer them for adoption. Section 18 provides for a clear cut agreement prior to construction between the developer and the sewerage authority. A considerable step forward would be provided for by a national agreement on the standards and conditions which must be met by the water and housebuilding industries. Such an agreement has been reached. As far as the design and layout of sewers is concerned, the standards required are generally in line with the present British Standard Code of Practice for sewerage, CP2005. One long standing problem has been the supervision allowed by Section 18 on the part of the sewerage authority. The building company generally does not object to the fact that supervisors from the sewerage authority are present, but does object to having to pay for this. Another problem concerns the provision of a guarantee to the authority that the builder would actually carry on and finish the sewers as agreed. The third problem has to do with sewage pumping stations. These problems are dealt with in the housing developer's guide. (Baker-FRC)
W82-04655

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,
La Societe d'Energie de la Baie James, Montreal (Quebec).
K. R. Ludwig, and R. T. Olive.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 183-198, December, 1981. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Spillways, *Flow control, *Hydraulic gates, James Bay, *La Grande Complex, *Quebec, Hydraulic structures, *Reservoirs, Water resources development, Gates, Hydraulic design, Flow velocity, Design criteria, Concrete, Maintenance, Cold weather construction, Bridges, Ice, Dam construction, Hydroelectric plants.

The structural conception of the major spillways and control structures of Quebec's six-reservoir La Grande Complex is summarized. All spillways and control structures contain a gate structure and a downstream discharge facility. Concrete has been used only where necessary to control flow, since the resistance of rock in this region is superior to concrete. The standardized gate opening is 40 ft, and all gates are of the flat, wheeled, vertical-lift type. The number of gates varies with the discharge capacities. Flow velocities have been limited to 60 ft per sec at the sill and 100 ft per sec at the downstream end for structures in intermittent operation. Control structures in use for prolonged periods are limited to a maximum velocity of 60 ft per sec for no more than 10% of the time. Drainage systems are located in areas protected against freezing, and gates are equipped with electric deicers. The dam bridge, aligned with the crest to either side of the spillway, is upstream of the stoplogs. Discharge from the gate structures is handled in a variety of ways, depending on the location. These include stilling basins, rock cut channels to the lake or river, chutes, flip buckets, intervening lakes, plunge pools, and combinations of these. (Cassar-FRC)
W82-04692

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,
Tudor Engineering Co., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-04693

TAPERED INLET DESIGN USING SPECIFIC ENERGY CURVES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller, and M. D. Dougal.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 127-135, January, 1982. 4 Fig, 5 Ref.

Descriptors: *Design criteria, *Culverts, *Inlets, Hydraulic structures, Water conveyance, Conduits, Pipes, Highways, Iowa, Specific energy curves, Economic aspects.

Design charts for the hydraulic design of tapered inlet highway culverts are given for both rectangular (box) and circular (pipe) sections. Errors, design time, and construction costs are greatly reduced by use of these charts. In Iowa savings from the use of tapered culverts at individual sites range from $1000 to over $100,000, for a total of millions of dollars over the past few years. The raised inlet culverts can form ponds for recreation or stock watering and help stabilize the upstream channel slope. For box culverts the chart plots depth in feet against specific energy head in feet for different ratios of design discharge to width of culvert. For pipe culverts, depth to pipe diameter ratio is plotted against specific energy to diameter ratio for different values of Q squared divided by D to the 5th power, where Q = design discharge and D = diameter of pipe. (Cassar-FRC)
W82-04695

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,
Connecticut Water Co., Clinton.
For primary bibliographic entry see Field 5F.
W82-04699

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,
Whitman and Howard, Inc., Wellesley, MA.
For primary bibliographic entry see Field 5G.
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,
Globe Linings Inc., Long Beach, CA.
For primary bibliographic entry see Field 5G.
W82-04702

8B. Hydraulics

ASYMPTOTIC SOLUTION FOR DAM-BREAK PROBLEM,
Cantebury Univ., Christchurch (New Zealand).
B. Hunt.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 115-126, January, 1982. 6 Fig, 9 Ref.

Descriptors: *Dam failure, *Kinematic wave theory, *Flood waves, Wave propagation, Hydraulics, Reservoir releases, Water flow.

The kinematic wave approximation is used to obtain a simple, closed-form solution for the catastrophic failure of a dam upon a dry, sloping channel. The solution validity is investigated by computing orders of magnitude for neglected terms in the equations of motion and by comparing the solution with the results of previously calculated numerical solutions and with experimentap results. These calculations and comparisons suggest that the kinematic wave solution becomes asymptotically valid after the flood wave has advanced about four reservoirlengths downstream. (Author abstract)
W82-04313

MEASUREMENT OF AIR IN FLOWING WATER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-04322

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
R. Kazmann.
Technical Report No 9, December 181. 68 p, 27 Fig, 22 Tab, 16 Ref, 2 Append.

Descriptors: *Wells, *Pump wells, *Injection wells, Recharge wells, Site selection, Water cooling, Well water, Heated water, Thermal pollution, Aquifers, Cooling, Air temperature, Water table decline, Conservation, *Louisiana, *Energy conservation, Heat pumps.

Acceptance of water-source heat pumps has been slow because of potential environmental impacts

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(water-level declines, subsidence, injecting substances into aquifers), cost, and lack of design data. The purpose of this work was to determine proper well spacing for single sets of twin wells, and for multiple sets; to examine the feasibility of their use in two Louisiana parishes; and to determine the potential use, economics, and environmental impact of water-source heat pumps. The use of twin wells--one to pump water, one to recharge the aquifer--precludes groundwater declines and, if properly spaced, avoids altering the groundwater temperature. The well used for production in summer is used for injection in winter, and vice-versa. A table is given to approximate the needed spacing between the wells. Even using an annual interest rate of 14%, a water-source heat pump and single well combination is often the most effective system for heating/cooling. In many areas of the two parishes studied, this system will be economical, especially in areas underlain by groundwater at shallow depth. Also, if properly designed and built, twin well systems will have no environmental impact on the biosphere and only minimal thermal impact on the source aquifers. It is recommended that no legislation be adopted that would prevent use of the system for those wanting to conserve energy; that research be encouraged to achieve higher coefficients of performance by use of a new working fluid, an increase in the throughput of water, or by reducing head loss in a unit; and that a streamline-tracking program be prepared to compute the consequences of operating large numbers of well pairs. (Atkins-Omniplan)
W82-04387

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Turner, Collie and Braden, Inc., Houston, TX.
For primary bibliographic entry see Field 8A.
W82-04558

STORM SEWER FLOW COMPUTATIONS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W82-04640

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,
Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
A. Qadar.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 739-757, September, 1981. 13 Fig, 8 Tab, 10 Ref.

Descriptors: *Scour, *Vortices, *Erosion, Sediment transport, *Piers, Rivers, Hydraulics, Riprap, Bridges, Flow around objects, Flow characteristics, *Bridge piers.

A tilting non-recirculating flume (0.3 m wide x 0.45 m deep x 5 m long) was used to study the vortex scour mechanism at bridge piers. First, experiments were performed on a rigid bed to study the behavior of the scouring vortex. Second, a sand bed was installed to measure the depth of scour holes. Results of field tests at several bridges in India and Canada were also reported. Several conclusions were developed from the observations. The basic mechanism of localized scours was identified as a secondary circulation caused by an upstream flow separation ahead of the pier. The maximum depth of the scour is a function of the strength of the vortex which develops ahead of the pier and is described in an equation containing the following terms: initial strength of vortex, an experimentally determined exponent to sediments up to 0.5 mm in diameter. For larger-sized sediments, roughness elements cause a reduction in scour. Although the depth of the approach flow has little measurable effect on maximum scour depth, there is a minimum depth of flow necessary for full development of vortex action. Scouring may be prevented or reduced by installing large-size riprap around piers or by weakening the basic mechanisms. (Cassar-FRC)
W82-04642

FLOW RESONANCE IN RIGID PIPES WITH REGULAR LONGITUDINAL CORRUGATIONS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
P. Latinopoulos, and D. K. Tolikas.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 263-267, March, 1981. 3 Ref.

Descriptors: *Pipe flow, *Resonance, *Flow characteristics, Wave propagation, Hydraulics, Water hammer.

The method of multiple scales was used to derive a uniform first order expansion for the condition of resonance in a corrugated pipe. Weak waves caused by small undulations on the pipe wall can be generated. Under certain conditions a resonance occurs that is independent of water hammer or resonance due to reflections at the boundaries of the system. Resonance can be expected when the wave number of the wall undulations matches the difference of the wave number of any two propagating nodes which are strongly coupled and travel unattenuated along the pipe. (Cassar-FRC)
W82-04644

ANALYSIS OF THE HYDRAULIC JUMP WITHIN A DIVERGING RECTANGULAR CHANNEL,
University of Wales Inst. of Science and Technology, Cardiff.
P. W. France.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 369-378, June, 1981. 6 Fig, 8 Ref.

Descriptors: *Hydraulic jump, *Spillways, Dam design, *Channel flow, Flow characteristics, Froude number, Model studies.

Properties of hydraulic jumps with parallel-sided channels and gradually diverging rectangular channels were compared theoretically and in laboratory flume studies. An equation was developed to predict the sequent depth in a diverging channel. The relative energy loss in a diverging channel was 12% higher than in a parallel-sided channel for the same Froude number. Although the energy loss was independent of the angle of divergence, it was a function of the sequent radius ratio. The lengths of diverging jumps were about 40% less than the straight-sided jumps for the same Froude number. The sensitivity of the jump became more stable as the angle of divergence increased. (Cassar-FRC)
W82-04645

SIMULATION OF SURGES AFTER REMOVAL OF A SEPARATING BARRIER BETWEEN SHALLOWER AND DEEPER BODIES OF WATER,
University of Strathclyde, Glasgow (Scotland).
D. I. H. Barr, and M. M. Das.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 911-919, September, 1981. 9 Fig, 7 Ref.

Descriptors: *Surges, *Barriers, *Flow characteristics, Hydraulics, Water level, Channel flow, Roughness, Water depth, Simulation analysis.

Surges produced after removal of a barrier separating water bodies with surfaces at different levels were numerically simulated. The equations were based on the St. Venant equations as applied to the dry bed dam burst case. Laboratory measurements were taken in rectangular channels with both smooth and artificially roughened surfaces. Laboratory data were compared with numerical simulations on three bases: surface profiles, depth hydrographs, and front trajectories. Agreement between observed and calculated values was good. Increased rates of damping and lagging of the surge front were seen both in the smaller-scale experiments and in roughened channels. (Cassar-FRC)
W82-04685

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W82-04696

8C. Hydraulic Machinery

RIDING MILL PUMPING STATION,
For primary bibliographic entry see Field 8A.
W82-04292

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-04365

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 5G.
W82-04388

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,
La Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 8A.
W82-04692

8D. Soil Mechanics

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 8G.
W82-04321

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 95-114, January, 1982. 15 Fig, 2 Tab, 22 Ref.

Descriptors: *Slope stability, *Tractive forces, *Sediment transport, Channel erosion, *Stream banks, Sand, Erosion, Sedimentation, Flow velocity, Critical velocity, Turbulent flow, Drag, Soil mechanics, Hydraulics, Channel scour.

Although several criteria have been theoretically proposed for the critical shear stress of noncohesive sediment on side slopes of river and channel banks, no laboratory work on this problem has been reported. This paper presents a theoretical study on the incipient motion of sediment particles on side slopes, accounting for the effects o the viscous sublayer, turbulence, and lift force. A laterally tilting wind tunnel was used to measure critical shear stress on side slopes from 0 to 40 degrees. Wind velocity varied from 0 to 30 m per sec. Two grades of noncohesive sand with median diameters of 1.3 and 0.42 mm were used in the experiment. Results of the wind tunnel tests confirmed the theory presented in this paper. On level beds the incipient motion of sand particles was essentially stochastic for the 1.3 mm sand, with a few particles first set in motion in isolated spots. The 0.42 mm sand particles moved intermittently as a unit. Although the lift force can be neglected when using the most probable values of critical tractive forces, it should be included for safety. The present equation does not account for disturbances such as sand waves, channel irregularities, and bends. (Cassar-FRC)
W82-04368

WET DISPOSAL OF FOSSIL PLANT WASTE: CASE HISTORY,

Ebasco Services Inc., Norcross, GA.
For primary bibliographic entry see Field 5E.
W82-04385

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-04538

EVALUATION OF A CHIMNEY DRAIN DESIGN IN AN EARTHFILL DAM,
Geological Survey, Doraville, GA.
M. L. Maslia, and M. M. Aral.
Ground Water, Vol 20, No 1, p 22-31, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Mathematical models, *Earth dams, *Drainage systems, *Performance evaluation, Soil physical properties, Clays, Sand filters, Silt, Model studies, Mathematical studies, Numerical analysis, Pressure head, Seepage, *Wallace Dam, Georgia.

The finite element Galerkin method was used to formulate a numerical model to study the performance of a vertical drainage filter in a clay fill zone of the Wallace Dam on the Oconee River, Georgia. The resulting model was applied to determine the steady-state saturated-unsaturated seepage characteristics at Station 58 + 00 on the west dike of the earthfill dam. Numerical results for the four cases (clay fill, sand filter, silty sand, and weathered) analyzed define the location of the zero pressure isobar and total hydraulic head values ranging from 130 m to 11 m. Using a saturated horizontal hydraulic conductivity of 8.64 cm/day, a maximum seepage velocity of 0.80 m/day was calculated, resulting in a maximum seepage rate of .752 cu cm/sec. An average pressure head reduction of 16 m from the upstream to the downstream side of the dam was determined from hydrostatic uplift forces along the base of the dam. When local seepage velocities were compared to critical seepage velocities inside of an upstream of the filter, safety factors against piping ranging from 0.3 to 3.7 were found. (Geiger-FRC)
W82-04675

8G. Materials

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,
Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
For primary bibliographic entry see Field 5F.
W82-04270

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
P. R. Vaughn, and H. F. Soares.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT1, p 17-31, January, 1982. 8 Fig, 18 Ref.

Descriptors: *Filters, *Dam design, *Cores, Sand filters, Soil filters, Clays, Dam failure, Soil mechanics, Grading, Permeability, Sediment sorting, Erosion, Cracks, *Balderhead Dam, *England.

The failure of a filter drain in the clay core of Balderhead Dam, Northern England, prompted a study of filter effectiveness and design. Although the grading of the crushed limestone filter material conformed to accepted designs, the possibility of cracks in the clay core had not been considered. In the Balderhead Dam erosion damage developed above a crack in the clay core. The damage zone contained lenses and other signs of segregation by water action. In some sections of the crack coarse particles accumulated, allowing small soil particles to be lost and enlarging the crack. A 'perfect' filter was designed for the Cow Green Dam and the Empsingham Dam to retain the smallest particles (in this case clay flocs) that can arise during erosion. Laboratory tests helped determine that natural, unwashed sand was suitable as the fine filter. An experimental relationship was found between the size of the particle retained by the filter and its permeability. In the laboratory uniformly-sized filter materials produced fail-no results. Graded filters showed a range during which slow clogging occurred. Permeability appears to be a better method of describing the retention characteristics of a filter than grading. (Cassar-FRC)
W82-04321

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-04421

8I. Fisheries Engineering

ENGINEERING IN CATFISH PRODUCTION,
P. Forsythe.
Agricultural Engineering, Vol 61, No 6, p 18-21, June, 1980.

Descriptors: *Fisheries, *Catfish, *Catfish farming, Catfish ponds, Fish harvest, Water pollution sources, Fish farming, Food processing wastes.

Scientifically managed catfish pond systems are used to produce an average yield of 3000 lb/acre. Optimum pond efficiency results from a layout of 8 ponds per 160 acre area each 660 ft by 1320 ft. The ponds are confined by levees having a 14 ft top width and 3:1 side slopes providing 2 ft of freeboard. The water area is about 17 acres. Th drainage of ponds at harvest creates significant shock loads to streams. The unused catfish feed plus wastes provides an enriched discharge. When fish are processed, processing wastes are treated usually in oxidation lagoons and discharged into city treatment systems. The handling and disposal of processing wastes needs the most attention from agricultural engineers. There is a tremendous opportunity to utilize these thousands of tons of fish protein. The effects on water quality of pond draining also need further investigation. (Small-FRC)
W82-04367

STATUS REPORT ON STRIPED BASS ANALYSES,
California State Dept. of Fish and Game, Sacramento.
Staff report prepared for the State Water Resources Control Board, Sacramento, California, January 20, 1982. 47 p 21 Fig, 10 Tab.

Descriptors: *Fish populations, *Bass, *Fish food organisms, *Fish diets, Fish eggs, Regression analysis, Correlation analysis, Diversion, Fish foods, Food chains, Phytoplankton, Zooplankton, Distribution patterns, Powerplants, Striped bass, *California.

In 1976, the California Department of Fish and Game (DFG) submitted evidence to the State Water Resources Control board indicating that the abundance of young striped bass was largely controlled by the magnitude of Delat outflow and losses in water diversions by the Central Valley Project and the State Water Project. When the abundance of bass was lower than DFG's expectations, the evidence was reexamined. Four hypotheses were advanced--increased competition, diversion, food abundance, and outflow. Most testing used correlation or multiple regression analyses, but a limiting factor of these approaches was that they only determined whether variables vary in a similar manner. None of the hypotheses described the actual mechanisms controlling striped bass abundance since 1959. Other hypotheses are being tested. However, a common theme was the variations in Delta outflow in spring/early summer have a major effect on abundance. High flows spread striped bass over a larger area and expansion of habitat reduces intraspecific competition and, thus, survival. High flows also probably increase food supply for young bass. Several regression analyses indicate that stock size, not food supply, may have caused the unusually low abundance of striped bass since 1976, but that hypothesis, too, has been questioned because bass are so prolific and because of evidence of stock size limitation elsewhere. A basic problem is that striped bass populations have been increasing recently, so any variable with a declining trend is correlated with young bass abundance whether a cause and effect relationship exists or not. (Atkins-Omniplan)
W82-04386

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

SEARCH: A GAGED WATERSHED INVENTORY,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.
Water Resources Bulletin, Vol 16, No 5, p 894-899, October, 1980. 4 Fig.

Descriptors: *Information retrieval, *Watersheds, Computers, Surveys, Information systems, Hydrologic data collections, Data collections, Data storage and retrieval, *New York, *Streamflow, *Gaging stations.

The purpose of this paper is to provide the potential user of SEARCH with the information needed to implement its use. The purpose of the program is to provide a ready inventory and search of all gaged streams in New York along with a compilation of major parameters upon which a decision to use records from such a gage might be based. The method is adaptable to any other state or region. The method as described is adapted to an APL interactive terminal, allowing the operator to thoroughly search a large set of gaged watersheds to find sources of comparable hydrologic data for detailed analysis. Bases of the search include drainage basin size and elevation and geographical and temporal parameters. (Baker-FRC)
W82-04433

TNRIS: A SOURCE FOR WATER-RELATED DATA IN TEXAS.
Southwest and Texas Water Works Journal, Vol 63, No 4, p 10-11, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Data storage and retrieval, Information systems, Weather, Water quality, Water supply, Wells, Precipitation, *Texas, TNRIS.

The Texas Natural Resources Information System (TNRIS) stores, processes, and disseminates data and information on Texas' water and other natural resources to State agencies, other governmental agencies, universities, and the public. The system provides access to hydrological, meteorological, geological, biological, socioeconomic, and base data located in more than 300 automated files and over 150 manual files. Base data includes maps and remotely sensed data. TNRIS data files cover such areas as daily and monthly precipitation, daily pan evaporation, daily surface water conductance, surface water quality, daily suspended sediment, and water well measurements. Data for these files are supplied by the National Weather Service, the U.S. Geological Survey, the International Boundary and Water Commission, and Texas State agencies. In addition, TNRIS interfaces with data bases maintained by the U.S. Geological Survey, the Environmental Protection Agency, the Department of Commerce, the Department of Agriculture, and the Department of Energy. TNRIS is capable of providing computer-printed reports, graphic outputs, interface with remote terminals, statistical packages, computer-generated microform, geocoding, analysis of remotely sensed data, catalogs and indices, information on availability of specialized data, and ordering services. The System also conducts a variety of remote sensing and cartographic activities. TNRIS can be assessed

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by letter, telephone, terminal, or personal visit. (Carroll-FRC)
W82-04651

AN INTERACTIVE DATA MANAGEMENT SYSTEM FOR RIVER WATER QUALITY DATA,
Michigan Univ., Ann Arbor. School of Public Health.
R. A Deininger.
Water Research, Vol 16, No 1, p 31-36, January, 1982. 2 Fig, 13 Tab, 3 Ref.

Descriptors: *Water quality, *Data storage and retrieval, *Information systems, Computers, Rivers, Statistical analysis, *Ohio River basin.

A water quality data bank for interactive use is described. Unlike the STORET, NAQUADAT, and EIS systems in the U.S., Canada, and Scandinavia, respectively, this system allows the user to search, update, retrieve, and analyze data from a computer terminal without the help of specially trained personnel. This system, located at the University of Michigan, can be accessed by local telephone numbers in 100 U.S. and Canadian cities and by the TELENET system from European cities. The system is illustrated by a sample problem using a small water quality data base with values for 9 selected parameters from 35 monitoring stations in the Ohio River Basin. Statistical analysis can be performed using the MIDAS software system. Graphs may be displayed on a television screen. (Cassar-FRC)
W82-04659

10C. Secondary Publication And Distribution

ANNOTATED SELECTED REFERENCES ON NATURAL RESOURCES INVESTIGATIONS, COLLIER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Swayze.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1184, 1981. 45 p.

Descriptors: *Bibliographics, *Publications, *Natural resources, Hydrology, Geology, Ecology, Geochemistry, *Florida, *Collier County, Biology.

A data base for future natural resources investigations in Collier County, Fla., was initiated by compiling a selected annotated bibliography. This report provides references and annotations for selected reports released between 1950 and 1978. The references are presented by subject material as follows: biologic, ecologic, geologic, geochemical, and hydrologic. (USGS)
W82-04508

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Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SEASONAL STREAM TEMPERATURE CHANGES FOLLOWING FOREST HARVESTING,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 4C.
W82-04870

SURVEY OF PRESENT KNOWLEDGE ON CAVITATION IN LIQUIDS OTHER THAN COLD WATER (THERMODYNAMIC EFFECT),
International Association of Hydrological Sciences, Paris (France).
For primary bibliographic entry see Field 8B.
W82-05280

HETEROTROPHIC ASSIMULATION OF PHYTOPLANKTON AS AN INTEGRAL PART OF THE SELF PURIFICATION OF NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
M. I. Kuz'menko, and V. G. Klenus.
Hydrobiological Journal, Vol 16, No 5, p 103-104, 1980.

Descriptors: *Bacteria, *Algae, *Oxygen uptake, *Phytoplankton, Heterotrophic bacteria, *Self purification, Organic matter, Assimilative capacity.

Oxidative heterotrophic assimilation by phytoplankton and bacterioplankton was demonstrated by differences in oxygen uptake in natural water (18.75-21.80 mg 0 per g dry matter for algae and 65.09-101.42 for bacteria) and in water with added organic matter such as amino acids and sugars (19.75-65.20 mg 0 per g dry matter per hour of exposure for algae and 71.93-818 for bacteria). Oxidative heterotrophic assimilation of algae was 1.59-5.67 times greater than that of bacteria for the stated level of biomass when calculated per unit volume. (Cassar-FRC)
W82-05326

STUDIES ON OXYGEN TRANSFER MODELS,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
T. Matsuo, and K. Hirayama.
Water Science and Technology, Vol 14, No 1/2, p 321-329, 1982. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Self-purification, *Turbulent flow, *Oxygen transfer, Model studies, Liquid film coefficient, Air-water interfaces, Energy dissipation, Temperature effects, Flow velocity, Eddies, Hydraulic properties.

The liquid film coefficient, a measure of the rate of oxygen transfer at air-water interfaces, depends on hydraulic parameters such as velocity, depth, and particularly turbulence characteristics of the flow. Two kinds of turbulence parameters were evaluated: the turbulence energy dissipation, corresponding to smaller-scale movements designated by Kolmogoroff's micro-scale, and the root mean square velocity fluctuation, corresponding to larger scale movements such as eddies. Results of laboratory experiments measuring the turbulence parameters and investigations on the effects of water temperature imply that for the mass transfer mechanism at the air-water surfaces, larger scale turbulent motion is dominant over smaller scale motion. (Cassar-FRC)
W82-05349

CHARACTERIZATION OF PROPERTIES OF WATER,
Rochester Univ., NY. Distillation Research Lab.
K. Hickman, W. V. Kayser, D. K. Thakur, I. White, and H. J. Palmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236555, Price codes: A04 in paper copy, A01 in microfiche.
Report, July, 1981. 27 p, 16 Fig, 1 Tab, 17 Ref. OWRT(No 3236)(1), 14-30-3236).

Descriptors: *Water properties, *Water vapor, *Surface tension, *Surfactants, *Water surface profiles, Physical properties, Vapor pressure, Air-water interfaces, Ice-water interfaces, Capillarity, Supercooling, Ice formation, Water, Reservoir storage, Water temperature, Water stress, Water cooling, Distilled water.

Research summaries are provided, covering studies on various aspects of the properties of water: vapor recoil; surface tension; the isothermal water-vapor interface. In studies of vapor recoil from non-aqueous liquids (triethanolamine) during steady-state evaporation under vacuum, addition of 20-microliter solutions of relatively involatile surfactants (erucic acid, Igepal CO-210 and CO-970, vitamin E acid succinate) produced rapid torpidity, with the degree of imparted surface stability due to both the surface-activity and interfacial concentration of the surfactant. In another study using a slower induction of evaporation from water supercooled below -12 degrees, instead of the surface dividing as the temperature fell, instantaneous formation of an icy layer pitted by conical depressions was observed; this was explained in terms of vapor recoil. Other studies included: superheating and surface tensions of water at temperatures lower than the ambient boiling point; calculations of surface tension and the evaporation coefficient at the isothermal interface; increases in surface temperatures accompanying known heat input to the surface; and mathematical and experimental reservoir storage study of mixing of hot water layers over denser colder water. (Zielinski-MAXIMA)
W82-05540

EFFECT OF WATER TURBULENCE ON ILLUMINATION AT DEPTH,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. I. Bykovskiy.
Hydrobiological Journal, Vol 16, No 6, p 46-49, 1980. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Light penetration, *Turbulent flow, Algae, Productivity, Physical properties, Wave refraction, Flow, Wavelengths.

Light penetration into water of varying turbulence was studied in an aquarium equipped with a pump which produced turbulence without air entrapment. Illumination was measured at a depth of 0.27 m. The light attenuation factor correlated with turbulence and varied from 2.9-4.5 per meter for stagnant water to 4.8-6.4 per meter for highly turbulent flow (Reynolds number 200,000). Light of different spectral wavelengthes was unequally attenuated by the moving flow. The blue-violet range of the spectrum was attenuated 1.1-1.5 times more strongly than the red at flows of R = 20,000-30,000, but at R = 200,000 the difference disappeared. The yellow-green range of the spectrum correlated with turbulence and did not show any anomalies. Turbulent flow can be harmful to algal growth in two ways: by decreasing total illumination (decreases productivity) and by producing wave lenses or small areas of great light intensity (destroys cell pigments). (Cassar-FRC)
W82-05594

1B. Aqueous Solutions and Suspensions

CONTROLLED NUCLEATION AND QUASI-ORDERED GROWTH OF ICE CRYSTALS FROM LOW TEMPERATURE ELECTROLYTE SOLUTIONS,
Lyon-1 Univ., Villeurbanne (France). Lab. de Physique des Materiaux.
For primary bibliographic entry see Field 2C.
W82-05123

THE EFFECT OF PRESSURE ON THE SOLUBILITY OF MINERALS IN WATER AND SEAWATER,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Geochimica et Cosmochimica Acta, Vol 46, No 1, p 11-22, January, 1982. 9 Fig, 15 Tab, 48 Ref.

Descriptors: *Solubility, *Minerals, *Atmospheric pressure, *Seawater, Compressibility, *Surface water, Mathematical studies, Volumetric analysis.

Recently, several attempts have been made to use molal volume and compressibility data to estimate the effect of pressure on ionic equiliria such as the ionization of acids, the formation of ion pairs, and the solubiity of minerals in water and seawater. Equations are presented for estimating the effect of pressure on the solubility of minerals in water and seawater and for determining the volume and compressibility changes at one atmoshere of pressure. The values of the partial molal volume and compressibility in water and seawater are tabulated for several ions at temperatures ranging from 0 to 50 C. The large compressibility change found for the solubility of most minerals accounts for the large differences which have been observed between values of partial molal volume obtained from linear plots of compressibility versus atmospheric pressure and molal volume data. Calculated values for the solubility of several compounds in water were found to be in good agreement with direct measurements. Similar calculations for the solubility of minerals in seawater were also found to be in good agreement with direct measurements, providing that the surface of the solid phase is not appreciably altered. The reported tabulated data can be used to make reasonable estimates of the effect of pressure on the solubility of minerals and other ionic equilibria in water and seawater. (Carroll-FRC)
W82-05135

2. WATER CYCLE

2A. General

EFFECTS OF USE PATTERN, COVER, SOIL DRAINAGE CLASS, AND OVERWINTER CHANGES ON RAIN INFILTRATION ON CAMPSITES,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 2G.
W82-04858

BACTERIOLOGICAL QUALITY OF SURFACE AND SUBSURFACE RUNOFF FROM MANURED SANDY CLAY LOAM SOIL,
Department of Agriculture, Ottawa (Ontario).
J. L. B. Culley, and P. A. Phillips.
Journal of Environmental Quality, Vol 11, No 1, p 155-158, January-March, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Agricultural runoff, *Bacteria, Fecal coliforms, Water quality, Coliforms, Water pollution sources, *Manure, *Farm wastes, Runoff, Seasonal variation.

The objectives of this study were to investigate the bacteriological quality of snowmelt surface and subsurface discharge from corn cropland receiving different rates of liquid dairy manure at different application times and to measure survival rates of indicator organisms in winter-spread manure. A gently sloping field of imperfactly drained Manotick sandy clay loam was divided into 14 plots which had been cropped in silage corn since 1973. After an intial year when no manure was applied, liquid dairy manure treatments at three rates and four different application periods were randomized and assigned to each plot for a period of 6 years. Liquid manure application rates averaged 105, 264, and 420 cubic meters per ha per year. The bacteriological quality of runoff from manured, corn-cropped sandy clay loam indicated that both spring snowmelt surface and subsurface discharge from winter applied treatments contained higher numbers of indicator organisms than did similar runoff from plots manured either the previous spring or fall. There was also some evidence that June storm surface runoff from spring treatments contained higher bacterial densities than did plots that received manure the previous winter or fall. Survival of fecal streptococcus organisms in surface applied frozen manure was noted, while both total coliform and fecal coliform densities declined to low

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levels within 40 days after application. Results indicate that land should be manured and plowed in the fall, prior to freeze-up, in order to minimize microbial densities in runoff during the following spring. (Baker-FRC)
W82-04880

CYCLIC FLUCTUATIONS IN THE FLOOD AREA AND RELATIONSHIP WITH THE DOUBLE (HALE) SUNSPOT CYCLE,
Indian Inst. of Tropical Meteorology, Poona.
H. N. Bhalme, and D. A. Mooley.
Journal of Applied Meteorology, Vol 20, No 9, p 1041-1048, 1981. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Flood forecasting, *Weather patterns, Forecasting, *Sunspots, Weather, Distribution patterns, Mathematical studies, *India, Western United States.

In this paper the possible relationship between the double sunspot cycle and the variation of the Flood Area Index over India is investigated. Harmonic analysis is used, and power spectrum and cross-spectrum analysis to relate the Flood Area Index series to the series of sunspot numbers of the double sunspot cycle. The power spectrum analysis reveals a highly significant approximately 22 year cycle in the Flood Area Indices over India. Harmonic analysis of the same record also shows a well marked 22-year Flood Area Index cycle in phase with the souble sunspot cycle. The Drought Area Index series shows a weak quasi-periodicity of 2.7-3.0 years. Cross spectrum analysis presents strong evidence that the 22 year FAI cycle over India is related to the double sunspot cycle. Further, the 22 year FAI cycle is nearly in phase with the double sunspot cycle. Harmonic dial analysis s hows that all of the large scale flood events over India occurred consistently in the major sunspot cycle and none occurred in the minor sunspot cycle. Large scale drought events have no preference to the phase of the sunspot cycle. The strong evidence for a relationship between the areal extent of the floods over India and the double sunspot cycle reported shares in the kind of sun climate relationship reported for the western United States, but for flood rather than drought. (Baker-FRC)
W82-04896

NUMERICAL MODELING STUDY OF LAKE PONTCHARTRAIN,
NOAA Data Buoy Office, NSTL Station, MS.
G. D. Hamilton, C. W. Soileau, and A. D. Stroud.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW1, p 49-64, February, 1982. 13 Fig, 1 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Lakes, *Wind tides, *Water level fluctuations, Mixing, Particulate matter, Numerical analysis, *Water circulation, Model studies, Tidal effects, Monte Carlo method, Mathematical models, Mathematical studies, Wind-driven currents, Friction, Advection, Surface velocity, *Lake Pontchartrain, Louisiana.

Actual wind circulation, water levels, and particulate matter dispersion in Lake Pontchartrain were simulated by a Hansen-type hydrodynamic numerical model utilizing an explicit numerical difference scheme. The model utilizes a leap-frog integration through time of the two-dimensional Eulerian form of the hydrodynamic equations to achieve a dynamical boundary-value solution of tidal order. Differential equations are derived by integrating x and y velocity components through a layer of assumed uniform density to yield vertically averaged mean components. The model also includes terms to account for the rotation of the earth, dissipative friction, and wind and tidal forcing. A Monte Carlo stochastic process helps to define diffusion and advection. The present paradigm was successfully applied to the estimation of lake surface movement by tides and wind and to the modeling of injunction and plume dispersion of particulate matter in lakes. (Geiger-FRC)
W82-05006

APPLICATION OF A TWO-DIMENSIONAL MODEL OF FORMATION OF STORM RUNOFF TO CALCULATION OF THE RAIN-WATER COLLECTOR-DRAIN DISCHARGE FROM AN URBANIZED TERRITORY,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. N. Demidov, and N. P. Lobanskaya.
Water Resources, Vol 8, No 2, p 126-132, March-April, 1981. 2 Fig, 3 Ref. Translated from Vodnye Resursy, No 2, p 65-71, March-April, 1981.

Descriptors: *Urban areas, *Drainage engineering, *Storm runoff, Runoff, Urban runoff, *Model studies, *Industrial development, Rainfall-runoff relationships, *Nizhnekamsk, USSR.

A two-dimensional model of runoff formation was used to calculate the collector drain discharge at a 0.365 sq km industrial complex under construction at Nizhnekamsk. It was possible to account for the characteristics of the relief of an urbanized area, the characteristics of its underlying surface, and the parameters of the rainwater collecting system. Comparing the results of the two-dimensional model with those of the isochrone method showed that the isochrone method overestimated values of maximum water discharges by as much as 38%. The two-dimensional method can also be used for designing a collection system. (Cassar-FRC)
W82-05027

ATMOSPHERIC MOISTURE TRANSPORT AND THE WATER BALANCE OF THE MEDITERRANEAN SEA,
Lisbon Univ. (Portugal).
J. P. Peixoto, M. de Almeida, R. D. Rosen, and D. A. Salstein.
Water Resources Research, Vol 18, No 1, p 83-90, February, 1982. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Atmospheric water, *Evaporation, *Hydrologic budget, Wind, Precipitable water, *Mediterranean Sea, Water vapor, Climatology, Weather patterns, Hydrologic cycle, Salinity, Air circulation, Precipitation rate, *Water balance.

The water balance of the Mediterranean Sea was obtained from the net difference between evaporation and precipitation rates by evaluating the divergence of the atmospheric flux of water vapor over the region. Upper air data from 1968-1973 were used to compute this value. The net difference between evaporation and precipitation from this study was 55,000 cu m per sec, compared with 59,000-67 cu m per sec obtained by other authors using more classical methods. Maps are printed showing the two-dimensional fields of precipitable water, the vertically integrated water vapor flux vector, and the divergence of water vapor over the region. The Mediterranean is not a closed system. Moisture enters from distant sources including the Atlantic, and a larger amount of water vapor is exported from the area to the Middle East and northeast Africa. Precipitable water averages 22.4 kg per sq m and totals 56 billion cu m over the whole sea. Three main centers of high water vapor content (over 24 kg per sq m) are found over the western Mediterranean, the Aegean, and the Levantine basin. Minima are found over desert areas, regions of high terrain, and over islands. Although the moisture transport pattern over the Mediterranean is generally west-to-east, there are nonuniformities. The Alps block the dominant westerlies and lead to dry air in the northern Adriatic. Drier air over Turkey is related to topographic effects. Southward transport dominates in central and eastern Mediterranean and northern transport over the Alboran Sea and Italy. The net meridional flow is 20 kg per m southward. Areas of strong divergence are found in the Levantine Basin and from south of Italy to the Libyan coast. Convergence zones, less widespread, are found over the Aegean, the Adriatic, the south of France, and the west African coast towards Morocco. (Cassar-FRC)
W82-05050

BEDROCK AQUIFERS IN THE LOWER DIRTY DEVIL RIVER BASIN AREA, UTAH, WITH SPECIAL EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05220

PEAK RUNOFF MODEL COMPARISON ON CENTRAL ILLINOIS WATERSHEDS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. Mostaghimi, and J. K. Mitchell.
Water Resources Bulletin, Vol 18, No 1, p 9-13, February, 1982. 4 Tab, 12 Ref.

Descriptors: *Watersheds, *Runoff rates, *Flood peaks, Mathematical models, Model studies, Performance evaluation, Statistical analysis, Areal hydrology, Illinois.

Although estimates of peak flows are needed for the design of the thousands of hydraulic conveyances and structures built each year, it is physically and economically impossible to measure runoff from each watershed for which such and estimate is required. As a result, it is necessary to extend the results of peak runoff measurements made in a small number of watersheds to ungaged areas. Four models for predicting peak runoff rates in watersheds of mild topography were selected and compared to determine the model most applicable to the small agricultural watersheds of east-central Illinois. The 15 watersheds used for this study are representative of slopes, soils, and land-use patterns found throughout much of the area. Rainfall and runoff measurements were available continuously since 1949 for four watersheds at Allerton Park, while data were available for the other watersheds for various lengths of time between 1955 and 1970. The Cypress Creek, Rational, Chow, and Soil Conservation Service (SCS) peak runoff models were found to be appropriate for the available data and physical conditions of these watersheds. Evaluations of the performances of these models showed that: (1) the Cypress Creek model underpredicted peak flow for most of the watersheds; (2) the Rational model overestimated the peak flow rates for most of the watersheds; (3) the Chow model generally resulted in better estimates of peak runoff for the Allerton watersheds than for the other watersheds; and (4) the SCS model was considered to be best for predicting peak runoff rates from these mild topography, agricultural watersheds. Error-mean-square tests confirmed that the SCS model predicted peak runoff rates better than the other three models for all but two watersheds. (Carroll-FRC)
W82-05489

ON THE RELATIONSHIP BETWEEN THE RELIABILITY OF PARAMETER ESTIMATES AND HYDROLOGIC TIME SERIES DATA USED IN CALIBRATION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Water Resources Research, Vol 1, No 1, p 146-154, February, 1982. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Streamflow, *Time series analysis, Parametric hydrology, Model studies, Precipitation, Stochastic process, Ocala, Florida, Watersheds, Rainfall-runoff relationships, Groundwater, Runoff, Estimating, Calibrations, Soil water.

Parameters of conceptual hydrologic models are calibrated using limited information, input-output time series data, such as precipitation and streamflow. The sources of stochasticity in these models are identified. Conditions under which parameter estimates are consistent are: (1) the structure of the model represents without bias the internal hydrologic transfers, (2) the hydrologic transfers are deterministic in the sense that state-dependent fluxes can be predicted with negligible error, and (3) measurement errors on observable driving fluxes are negligible. Improving the stability of parameter estimates is considered. On the first information level the first two moments of measurement errors are used to make large sample bias corrections. The second level uses time series data corresponding to storage volumes such as groundwater and

soil moisture to remove the source of inconsistency due to erroneous influence of estimated storage volume and to improve the stability of parameter estimates. Proper exploitation requires that the estimation procedure exploits the interdependence of model equations arising from coupled model structure and correlated disturbances. The generalized least squares procedure offers a promising approach for exploiting all available time series information in model calibration. An example features hydrological data from a watershed near Ocala, Florida. (Cassar-FRC)
W82-05490

RIVER-BASIN SIMULATION IN SYSTEMS WITH LARGE RESPONSE TIME,
Massachusetts Inst. of Tech., Cambridge, Dept. of Civil Engineering.
V. P. Nogueira, J. L. Wilson, and K. Strzepek.
Journal of Hydrology, Vol 51, No 1-4, p 159-168, May, 1981. 6 Ref.

Descriptors: *Simulation analysis, *River basins, Performance evaluation, Optimization, Cost analysis, Systems analysis, Mathematical equations, Mathematical studies, Markov process.

Two common problems encountered in the static simulation of a river basin are the determination of the simulation length and the balancing of the effect of the initial conditions on the system measures of performance. Since it is impossible to formulate general solutions to these problems, some general guidelines are developed and applied to the specific case of a simple system in which a synthetic sequence was used as input and an output sequence was obtained and assumed Markovian. The results show that Conway's rules, which suggest that data from some initial period be excluded from consideration and that starting conditions be chosen which make the necessary excluded interval as short as possible, can be implemented even though they seem to be rather general and loose. Care must be taken for each particular case, and a general idea about the output to be obtained must be developed before any rational action can be taken or any simplifying assumptions made. The costs of estimation must be balanced against the costs provoked by errors of estimation in order to determine the run length. Such analysis should be made even when computer costs are fixed or constant, so that compensation may be made for errors of estimation. Whenever possible, costs should be weighted before deciding between a long run and a series of replicated runs. Generally, replication results in increased bias due to the effect of initial conditions but decreased variance. It is suggested that this methodology can be used for practically every case if appropriate modifications are made. (Carroll-FRC)
W82-05496

ESTIMATION OF FLOOD PEAKS WITH LIMITED HYDROLOGIC DATA,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller, and J. O. Ngana.
Journal of Hydrology, Vol 51, No 1-4, p 151-157, May, 1981. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Flood peak, *Hydrologic data, *Prediction, Flood flow, Mathematical models, Mathematical equations, Developing countries, Tanzania, Africa.

In developing countries, designers of water projects are often confronted with the need to develop projects making the best use of very scanty hydrologic data and limited available capital. Flood data for instance, are often required on rivers having little or no recorded hydrologic data. In Tanzania, the government plans to proceed with hydropower and rural development in the Rukwa region, for which hydrologic data is very scarce. However, the drainage basins of the nearby Mbeya region are quite well monitored. Statistical analyses of the discharge data from selected catchments in the Mbeya region were compared with the TRRL (United Kingdom Transport and Road Research Laboratory) flood model results for the region. The high level of agreement between the results indicated that the TRRL model is applicable to Mbeya catchments. A regional flood-frequency study for the Mbeya catchments resulted in the development of a regional frequency curve of discharge ratios and of a curve of mean annual flood versus drainage areas of the basins. The TRRL flood model results and the regional frequency curve for the Mbeya region were then utilized in the Rukwa catchments. The results obtained from these two methods agreed well with each other, suggesting that both the TRRL flood model technique and the derived regional frequency curve can be used fairly well on ungauged catchments in the Mbeya and Rukwa regions where hydrologic similarity exists. Although more data would increase the accuracy of the results of the two methods, each method produced results of useful accuracy based on the limited data available. (Carroll/FRC)
W82-05521

KINEMATIC WAVE THEORY OF CATCHMENT RESPONSE WITH STORAGE,
Newcastle Univ. (Australia). Dept. of Civil Engineering and Surveying.
For primary bibliographic entry see Field 4A.
W82-05714

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-05837

QUANTITATIVE GEOMORPHOLOGY OF DRAINAGE BASINS IN SUMTER NATIONAL FOREST, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
G. G. Patterson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $7.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-417, 1981. 55 p, 1 Fig, 4 Ref, Append.

Descriptors: *Computer programs, *Geomorphology, *Small watersheds, *Drainage systems, Hypsometric analysis, Drainage density, *South Carolina, Sumter National Forest.

This report describes a computer program, written in Basic, that facilitates quantitative analysis of drainage basins and channel networks. The program was used to inventory 2,000 small watersheds in Sumter National Forest, South Carolina during 1980 and 1981. Drainage basins and stream segments were delineated in color on mylar overlays over U.S. Geological Survey 1:24,000-scale maps. Drainage basin characteristics were quantified and stored on eight-inch diskettes. The program can produce printouts and plots that summarize geomorphic data for each watershed. The program is adaptable to other locations. (USGS)
W82-05839

STATISTICAL ANALYSIS TO DERIVE IMPROVED STORMWATER QUALITY MODELS,
Union Coll., Schenectady, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-05857

COASTAL FRESH WATER DISCHARGE IN THE NORTHEAST PACIFIC,
Alaska Univ., Fairbanks. Inst. of Marine Science.
T. C. Royer.
Journal of Geophysical Research, Vol 87, No C3, p 2017-2021, March 20, 1982. 7 Fig, 17 Ref.

Descriptors: *Precipitation, *Water currents, Fresh water, Storms, Streams, Stream flow, Orography, Mountains, Pacific Ocean, Alaska, Coastal waters, Coastal streams, Advection.

In this paper the sources of runoff and advection for the northeast Pacific are discussed. Seasonal changes of the runoff and their effects on the coastal circulation are considered. The high precipitation rates produce large fresh water discharges which enter the ocean by way of numerous small rivers and streams. Therefore they act as a line source rather than a point source. This coastal discharge contributes at least 40% of the fresh water that enters the northeast Pacific from the atmosphere. The discharge is comparable to the mean annual discharge of the Mississippi River system. The fresh water creates a cross-shelf density gradient that drives an alongshore baroclinic jet. The width of this jet is less than 25 km, with speeds in excess of 100 cm/second. It extends along the coast from southeast Alaska at least to Kodiak Island. The flow is apparently maintained as a narrow current adjacent to the coast by wind stress that causes downwelling conditions here throughout most of the year. The coastal mountain ranges bordering the Gulf of Alaska act as a barrier to the storms that move easterly across the North Pacific. Adiabatic elevation of these moist air masses causes very high rates of precipitation. (Baker-FRC)
W82-05870

THE RESIDENCE TIME OF THE FRESHWATER COMPONENT IN THE ARTIC OCEAN,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
H. G. Ostlund.
Journal of Geophysical Research, Vol 87, No C3, p 2035-2043, March 20, 1982. 10 Fig, 3 Tab, 22 Ref.

Descriptors: *Ocean circulation, *Natural waters, Upwelling, Water currents, Dating, Snowmelt, Ocean ice, Arctic, Rivers, Runoff, Arctic Ocean, Polar regions, Arctic zone.

The time function of bomb tritium concentrations in river runoff to the Arctic Ocean was reconstructed from published data on tritium in precipitation, 1959-1975. The relationship between tritium and salinity indicated that sea ice melt and freezing affect the upper 10-60 meters of water in the Nansen Basin, increasing toward the Canada Basin to about 150 meters. The average age of the freshwater component is about 11 years from its first appearance at the shelf to its emergence from thee basin as a constituent of the modified Atlantic water in the East Greenland Current. In the Canada Basin the modified Atlantic water itself has the same residence time, since mixing may occur in several steps. The freshwater residence times could be revised downward by 1 or possibly 2 years if there is an unexpectedly large effect of air-to-sea molecular transport during initial formation of the halocline water. There are clear isotopic indications of snowmelt water penetrating the ice and freezing on its underside. In 1979 waters west of the Lomonosov Ridge down to 1200 meters and east of the ridge even at 2500 meters contained tritium at concentrations higher than one would expect in 1957 Norwegian Sea water, and most likely these waters entered the basin after 1965. This means that at these places and depths the Atlantic source waters are probably younger than 16 years and definitely younger than 20 years. (Baker-FRC)
W82-05872

AN ANALYSIS OF MEDIUM AND LONG DURATION EXTREME RAINFALLS IN THE SOUTHERN CAPE COASTAL LAKES REGION FOR THE PURPOSES OF FLOOD HYDROGRAPH GENERATION,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
A. H. M. Gorgens, and D. A. Hughes.
Water S. A., Vol 8, No 1, p 16-22, January, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Rainfall, *Flood hydrographs, Hydrographs, Lakes, Flood control, Precipitation, South Africa, Graphical analysis, Mathematical studies, Graphical methods, Simulation.

In order to develop an efficient and careful system of management of the movement of water within

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the scenic Wilderness Lakes in the south eastern Cape area of South Africa, a collaborative program was launched which has as one of its aims the development of a mathematical model of the dynamics of the Lake system. A major application of the lake system model is the simulation of lake level responses to the inter-lake exchanges during various combinations of flood events in the major influent streams and sand bar obstructions across the Touw River mouth. Different ameliorative measures can then be superimposed on the system model and their effects on the system simulated and evaluated. The extreme value analysis of 39 years of daily rainfall records revealed clear relationships between extreme rainfalls, return periods, durations equal to or greater than one day, and area. Graphs are presented which allow the user to determine an areal correction factor for a specific duration, return period and area. When multiplied by the relevant extreme rainfall for the whole area, the correction factor produces an extreme rainfall for the sub-area in question. Comparisons with other methods available in South Africa for estimating areally averaged design rainfalls suggest that lower return period rainfalls were usually below the ones determined in this study. The results warrant their use as input in the generation of improved flood hydrographs for the Wilderness Lakes study. (Baker-FRC)
W82-05899

2B. Precipitation

RAINFALL INTERSTATION CORRELATION FUNCTIONS: III. APPROXIMATIONS TO THE ANALYTICALLY DERIVED EQUATION OF THE CORRELATION FUNCTION FOR AN EXPONENTIAL STORM MODEL COMPARED TO THOSE FOR A RECTANGULAR AND A TRIANGULAR STORM,
Institute for Land and Water Management Research, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 52, No 3/4, p 269-289, July, 1981. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Rainstorms, *Correlation analysis, *Mathematical models, Numerical analysis, Mathematical equations, Rainfall, Precipitation.

The rainfall interstation correlation function can be analytically derived on the basis of a storm model. The interstation correlation function for the exponential storm model has a complicated structure and contains an arbitrary storm parameter (b) which must be established before the interstation correlation function for the model can be numerically evaluated. Choices for this parameter include (b) based on the shape of the storm profile, (b) based on minimum rainfall amounts that still can be observed, or (b) based on the storm volume of a triangular storm which has the same storm width. When the last choice is selected, it is possible to simplify the complicated structure of the correlation function for the exponential storm mode by means of sequential best approximations. The structure and properties of the correlation function for the rectangular, the triangular, and the exponential storm models can be compared using this simplified approximating form, providing insight into the behavior of the three storm models and their impacts on interstation correlation functions. In sampling rainfall data for correlation analysis, the effects of storm maximum, storm width, fraction of dry days, and area size should receive particular consideration. (Carroll-FRC)
W82-04864

A SELF-EVALUATING DISDROMETER FOR THE MEASUREMENT OF RAINDROP SIZE AND CHARGE AT THE GROUND,
Auckland Univ., (New Zealand). Dept. of Physics.
C. D. Stow, and K. Jones.
Journal of Applied Meteorology, Vol 20, No 10, p 1160-1176, 1981. 18 Fig, 2 Tab, 20 Ref.

Descriptors: *Rain, *Measuring instruments, Disdrometer, Rainfall, *Raindrop size.

This article considers the concept of instrument design to minimize effects of overlap and splashing in the measurement of raindrop size and describes an experiment which was conducted to provide direct evidence of inadmissible or unreliable data on drop size and charge, which should enable more useful spectra to be obtained than previously was possible. Fundamental errors include drop overlap which occurs at times of simultaneous occupation of the sampling volume by more than one drop, splashing, and the influence of the wind. The disdrometer described can determine the sizes of individual drops in the range of 0.1-2.5 mm radius and charges within the limits of magnitude 0.1-10 pC. Drop velocity and the detection of drop overlap within the charge sensitive volume can be accomplished by the use of two size detectors. Non-ideal data arising from natural conditions, measuring sites, and from fundamental or unavoidable deficiencies in disdrometer design could be tested and monitored automatically using a central processor under software control. The performance of the instrument was tested using individual drops generated in the laboratory and through exposure to natural rain falling through an aperture into a chamber shielded from wind and associated turbulence. Some improvements in the design of the current disdrometer are suggested. (Baker-FRC)
W82-04897

MOISTURE ANALYSIS FROM RADIOSONDE AND MICROWAVE SPECTROMETER DATA,
Florida State Univ., Tallahassee. Dept. of Meteorology.
K. J. Haydu, and T. N. Krishnamurti.
Journal of Applied Meteorology, Vol 20, No 10, p 1177-1191, 1981. 11 Fig, 27 Ref.

Descriptors: *Moisture profiles, *Spectrometers, Microwaves, *Remote sensing, Potential rainfall, Measuring instruments, Satellite technology, Moisture availability, Precipitation, Rainfall, *Atmospheric water.

This study exploited the objective of providing a detailed analysis technique for moisture over several vertical levels in the atmosphere. Two major problems were encountered: the need to formulate some type of a correction scheme to calibrate the satellite-derived total precipitable water and the development of an objective technique to obtain the vertical distribution of moisture. The method of analysis uses satellite, upper air and surface data. A brief overview of the microwave sensors on board Nimbus 5 and 6 is also included. The technique provided uses the radiosonde data sets to calibrate the satellite field of total precipitable water. The calibrated satellite-derived field is then used along with ship and coastal reports of moisture and thus provides a mapping of specific humidity at several levels in the troposphere. Using these procedures, analyses for several case studies were performed. The resultant maps showed detailed distributions of specific humidity along with interesting climatological features. A reasonable acceptance of the available aerological data sets by the analysis scheme is also demonstrated. (Baker-FRC)
W82-04900

DETERMINATION OF THE TOTAL PRECIPITABLE WATER BY VARYING THE INTERCEPT IN REITAN'S RELATIONSHIP,
Consiglio Nazionale delle Ricerche, Bologna (Italy).
C. Tomasi.
Journal of Applied Meteorology, Vol 20, No 9, p 1058-1069, September, 1981. 10 Fig, 17 Ref.

Descriptors: *Probable maximum precipitation, *Weather forecasting, Mathematical studies, Rainfall, Forecasting, Rain, *Precipitation, Dewpoint, Temperature.

Reitan in 1963 proposed a relationship between the total precipitable water and the dewpoint temperature at ground level in which the intercept was found to be a function of the scale height of the atmospheric water vapor and of the ground temperature. The scale height was closely related to the features of the vertical moisture profile in the low troposphere. The ground temperature is responsible for diurnal and seasonal variations of the intercept which are of little importance. The slope coefficient has a constant value. Using this as a base, a method is proposed which determines the nocturnal time pattern of the intercept by linear interpolation in time between the daytime estimates obtained from spectral hygrometer measurements. The nocturnal time pattern of the total precipitable water can be calculated from Reitan's relationship using these interpolated values of the intercept together with the nocturnal measurements of the dew point temperature at ground level. This method was satisfactorily applied to spectral hygrometer measurements made on several days. Estimates of the total precipitable water at two stations of the Po Valley were obtained from Reitan's relationship by using local measurements of the dew point temperature at ground level and suitable values of the intercept. (Baker-FRC)
W82-04901

FORESEEABLE EFFECTS OF CO2-INDUCED CLIMATIC CHANGE: FRESHWATER CONCERNS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Environmental Conservation, Vol 8, No 4, p 285-297, Winter, 1981. 3 Fig, 33 Ref.

Descriptors: *Carbon dioxide, *Climatology, *Research priorities, Air pollution, Temperature effects, Precipitation, Ecological effects, Water supply, Productivity, Species distribution, Sinks, Reservoirs, Water resources development, Arid climates, Streamflow, Water allocation, Aquatic life, Irrigation, Water pollution, Weather patterns, Cold regions, Algae, Eutrophication, Organic carbon, Estuaries.

The possible effects of increases in atmospheric carbon dioxide are a 2-3 C increase in global mean annual surface temperatures (least near the equator and most at 80 degrees north latitute, with anomalies in many locations) and precipitation changes (increased rainfall in some zones and increased aridity in others). These potential climatic changes many profoundly affect water resources availability and net productivity relationships and species distribution in aquatic ecosystems. High ranking research priorities include determination of the quality and quantity of organic materials transported by rivers into the ocean under present CO2 atmospheric conditions, determining whether estuarine or marine environments are a significant sink for river carbon, determination of the effects of CO2 enrichment of the air and concurrent temperature and precipitation changes on aquatic productivity and eutrophication of lakes, determination of changes in geographic ranges of commercially important and exotic aquatic species due to increased temperature, and development of plans for constructing water storage reservoirs in areas of increasing aridity. Medium-rank research priorities concern organic carbon deposits in sediments as a carbon sink, changes in water pollutant loads, effects on northern aquatic ecosystems from the elimination of permafrost, and the role of carbon in the organic load of rivers entering the sea. Several low-ranking priorities are also listed. (Cassar-FRC)
W82-05574

RECORDING RAINGAGE MODIFICATIONS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 7B.
W82-05665

IDENTIFICATION OF INDEPENDENT RAINSTORMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. J. Restrepo-Posada, and P. S. Eagleson.
Journal of Hydrology, Vol 55, No 1/4, p 303-319, 1982. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Atmospheric precipitation, *Rainstorms, *Statistical analysis, Arid climates, Saudi Arabia, Storms, Seasonal variation, Coefficient of variation, Forecasting.

Separation of point precipitation records into statistically independent storms is done according to the criterion of exponentiality of the time between storms. If the coefficient of variation for time between storms is unity, the storms are considered independent. An algorithm is given for obtaining the above coefficient from a given storm sequence for successively larger minimum storm separation. Estimates of the time between independent storms obtained in this manner produce Poisson distributions of annual precipitation which agree well with observed distributions at 3 arid climate sites in Saudi Arabia. Values of time between independent storms from 17 stations with annual rainfalls varying from 24 to 5107 mm correlate with the rainy season monthly precipitation, providing a means of estimating time between independent storms from mean annual rainfall and mean length of rainy season. (Cassar-FRC)
W82-05708

REVISED RAINFALL FREQUENCY ANALYSIS FOR HOUSTON,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
T. C. Bouvette, J. L. Lambert, and P. B. Bedient.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 515-528, April, 1982, 7 Fig, 6 Tab, 24 Ref.

Descriptors: *Rainfall, *Frequency analysis, Mathematical studies, Regional analysis, Precipitation, Frequency distribution, Houston, Urban areas.

A study was designed to determine whether significant rainfall pattern and intensity changes have occurred in the Houston area since 1960. Such changes are associated with contemporary urban development and could help to explain the severe flooding problems encountered in recent years. Data was analyzed by four Houston area stations. The data indicated that the downtown station is receiving less rainfall and the areas around Houston are receiving more rainfall, as the Double Mass analysis illustrated. The 100 yr design storms indicated an increase in rainfall intensity occurring around the Houston area, while the downtown 100 yr design stroms indicate a decrease in rainfall intensity since the 1960 United States Weather Bureau effort. The number of recorded extreme events occurring downtwon has also diminished since 1960. The change in rainfall intensity could have come about through a shading effect caused by the increased density of tall buildings downtown, which could cause inaccurate gaging. However, this does not explain the observed increase in rainfall outside the downtown area. The increased extreme event intensities outside of the downtown area indicate a potential problem in designing drainage and sewer systems. Reevaluation of design storm parameters should be done periodically, no less than once every five years in growing urban centers. (Baker-FRC)
W82-05863

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES. I. SWARTKOPS RIVER,
National Physical Research Lab., Pretoria (South Africa).
R. J. Watling, and H. R. Watling.
Water S. A., Vol 8, No 1, p 26-35, January, 1982. 4 Fig, 10 Tab, 9 Ref.

Descriptors: *Trace metals, *Estuaries, Estuarine environment, Water pollution sources, Rivers, South Africa, Copper, Lead, Zinc, Nickel, Oysters, Monitoring, Brickworks, Outfalls, Municipal sewage.

The results of a detailed trace metal survey of the Swartkops River, South Africa, are reported. Oysters growing at the mouth of the river contained considerably more zinc, copper and lead than had been determined for the same species growing at other locations on the South African coast. Surface water samples were collected in 2.5 foot high density polyethylene bottles. Surface sediment and sediment core samples were also collected up to 15 km from the mouth of the Swartkops River and analyzed for up to 16 elements. Four main areas of contamination were thus found: at Redhouse, Swartkops, a brickworks, and Amsterdam Hoek. Large accumulations of zinc, copper lead and nickel by the oysters at the mouth confirm the presence of greater than normal metal concentrations in the river. The Swartkops area may obtain a contribution from the power station effluent, and Uitenage and Despatch municipal effluents probably contribute to the contamination of the Redhouse area. The Fishwater Flats sewer outfall appears to be a further source of contaminants but may not be significant in terms of metal buildup, as tidal sweep disperses the effluent relatively quickly. At the present time the concentration of metals in the area is not viewed as cause for alarm. Monitoring should be made at specific sites of input of these contaminants to establish long term trends. (Baker-FRC)
W82-05898

VARIATIONS IN MOISTURE DEFICITS OVER THE MAIZE-GROWING REGION OF SOUTH AFRICA II: TEMPORAL ASPECTS,
Missouri Univ., Columbia. Dept. of Atmospheric Science.
J. F. Gillooly, and T. G. J. Dyer.
Water S. A., Vol 8, No 1, p 9-15, January, 1982. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Rainfall, *Temporal distribution, Precipitation, South Africa, Distribution, Semiarid climates, Seasonal variations, Moisture availability, Moisture, Plants, Maize.

A description of temporal variations in moisture deficits over the period of 1945 to 1974 in the maize-growing region of South Africa is offered. Temporal changes in moisture deficits were considered on two scales: first on a seasonal basis and then on a monthly time scale. Within each time scale temporal variation was examined on a regional basis and then for the maize growing area as a whole. These time series were then analyzed using Jenkinson's modified version of harmonic analysis, which removes the constraint placed on resolution in straightforward harmonic analysis and avoids the need to guess a maximum lag for use in the conventional spectral approach to analyses over the frequency domain. Moisture deficits were shown to be more severe and more variable in the dry western parts of the maize growing region of South Africa. The greater variability of moisture deficits in the west is of relevance to agricultural planning, as this is the area where maize is commonly grown under marginal dryland conditions. It has been possible to isolate months, or groups of months, during the growing season when deficits exhibit marked variability. Finally, the isolation of periods of above- and below-normal moisture deficits between 1945 and 1975 suggests that the moisture deficit term provides a potentially useful index for assesssing the impact of climatic variability on food production in South Africa. (Baker-FRC)
W82-05900

2C. Snow, Ice, and Frost

GLACIERS AND THEIR FLUCTUATIONS,
Swiss Federal Inst. of Tech., Zurich.
F. Muller.
Nature and Resources, Vol 16, No 2, p 5-11, April/June, 1980. 5 Fig, 1 Tab.

Descriptors: *Glaciers, *Climatic, *Climatology, Glacial drift, Glacier mass balance, Monitoring, International commissions.

Two international bodies, the Permanent Service on Fluctuations of Glaciers (PSFG) and the Temporary Technical Secretariat (TTS) for the World Glacier Inventory, both located at the Swiss Federal Institute of Technology, have been created to advance snow and ice research in the contexts of hydrology, technology, and climatic change. This TTS is charged with coordinating and assisting national glacier inventory efforts, collecting and standardizing data, making the data computer compatible in one system, eventually producing a global summary, and initiating and supporting analysis based on these data. The objective of the PSFG is to produce a global set of data on the fluctuations of glaciers which will provide a general view of the changes, encourage more extensive measurements, facilitate consultation, and serve as a data base for monitoring climatic change. Twenty-seven countries participate and regularly submit data on glaciers within their national boundaries or collected by their scientists elsewhere. Although it is generally accepted that glacier-tongue fluctuations are caused by changes in climatic conditions, data collected on over 800 glaciers show that there are great differences in the reactions of individual glaciers. However, the statistically averaged behavior of a sufficiently large number of glaciers within a certain region reflects changes in climate very reliably. It appears that mean annual temperature variations of less than 1 C can have a profound effect on glaciers, and that in some areas the summer temperatures have more influence than annual mean values. However, the complex chain of causal dependence within the climate-glacier relationship is not fully understood. Long-term measurements of both mass balance and climatic parameters on local and regional levels are needed in order to construct reliable quantiative models for prediction. (Carroll-FRC)
W82-04777

ICEBERGS: TECHNOLOGY FOR THE FUTURE,
Cambridge Univ. (England).
H. E. Huppert.
Nature (London), Vol 285, No 5760, p 67-68, May 8, 1980.

Descriptors: *Icebergs, *Water transport, *Water supply, Ice-water interfaces.

Presentations to a conference on The Use of Icebergs organized by the International Glaciological Society are summarized These presentations focussed on the physical characteristics of icebergs, including the way they break up and roll over; their melt-rate; and the feasibility of capturing and towing icebergs to locales where they could be used as freshwater supplies. Studies of the break-up of icebergs indicate that only very large ice sheets will remain intact as they drift far from their sources. Scaled towing tests conducted by Iceberg Transport International indicate that the most efficient means of propuslion is by hauling the iceberg on lines attached to a very large parachute drogue ahead of the iceberg. Reasonable efficiency may be achieved by using two drogues. Although it may be possible to process icebergs for water supply supplements using existing technology, little is known about the environmental effects of moving icebergs in shipping lanes could result in accidents. (Carroll-FRC)
W82-04778

A MECHANISM FOR THE FORMATION OF LARGE ICEBERGS,
National Hydrology Research Inst., Ottawa (Ontario).
G. Holdsworth, and J. E. Glynn.
Journal of Geophysical Research, Vol 86, No C4, p 3210-3222, April 20, 1981. 8 Fig, 1 Tab, 32 Ref.

Descriptors: *Icebergs, *Ice breakuup, *Floating ice, *Vibrations, Glaciers, Ocean waves, Tensile stress, Stress, *Antarctica.

The Antarctic ice sheet is connected to significant peripheral areas of floating ice, which calve to form icebergs, resulting in substantial losses in terms of ice mass budget. The largest type of iceberg is formed by the disintegration of massive, unconfined, seaward extending ice shelves or glacier tongues. A number of ice tongues are known to exhibit a quasi-cyclic pattern of calving and subsequent regrowth. One mechanism that would appear to explain this type of calving behavior is based on the vibrational characteristics of the system of a buoyant ice plate floating in shallow water. The glacier intercepts the ocean wave energy responsible for the motion either directly from open ocean or after transmission through, and subsequent filtering by, sea ice. The glacier also acts as a wave filter, with filtering characteristics depending on the thickness of the ice. When a

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dominant frequency occurring in the incident wave spectrum coincides with one of the natural frequencies of the glacier, then a resonant motion will occur. For relatively high modes of oscillation, low level but sustained cyclic bending stresses may lead to crack propagation and subsequent fatigue failure in the ice. The contributions of other mechanisms which induce tensile stresses in the ice are considered to be very important in an overall view of the calving problem, and some of these mechansism are discussed in relation to the vibration mechanism. It is possible to view the proposed vibration mechanism as a trigger which raises the resultant stresses in the ice to the point where fracture will occur. (Carroll-FRC)
W82-04798

FRESH-WATER TRANSPORT BY SEA,
Oufresne and Henry Engineers, Inc., North Springfield, VT.
For primary bibliographic entry see Field 6D.
W82-04861

RESISTANCE OF BEAUHARNOIS CANAL IN WINTER,
National Water Research Inst., Burlington, (Ontario).
G. Tsang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 167-186, February, 1982. 11 Fig, 1 Tab, 11 Ref.

Descriptors: *Canals, *Chezy equation, *Ice formation, *Flow resistance, *Electric power production, *Mannings equation, *Open-channel flow, Water management, Open channels, Roughness coefficient, Resistance, Frazil ice, Hydroelectric power, Streamflow, Ice cover.

Under natural conditions the Beauharnois Canal connecting Lake Saint-Louis and Lake Saint Francis would remain open until quite late in the winter, despite ice cover on Lake St. Francis. An open water surface invites frazil ice production, causing increased operational problems on the canal. The formation of ice cover on the canal is accelerated by placing ice booms across the canal to detain ice drift and initiate ice covers in front of them. As ice cover progresses, the resistance of the open canal to the flow changes and water resource utilization may be maximized. The flow in this canal was examined using the open-water Chezy equation while ignoring the presence of ice by using a corrective coefficient for Chezy's roughness coefficient. This corrective coefficient followed a well-defined trend during the frazil ice period which, when present in small amounts, could reduce the flow by as much as 50%. The present approach offers an advantage over using the Manning equation because it can handle situations where a river is only partially ice covered or is affected by frazil ice while avoiding a choice of formula for evaluating the composite Manning's roughness coefficient. A corrective coefficient curve was generated in the present study which may lead to an alternative ice management scheme and better electric power production on the Beauharnbois Canal. (Geiger-FRC)
W82-04998

A LABORATORY AND THEORETICAL STUDY OF THE BOUNDARY LAYER ADJACENT TO A VERTICAL MELTING ICE WALL IN SALT WATER,
Washington Univ., Seattle. Dept. of Oceanography.
E. G. Josberger, and S. Martin.
Journal of Fluid Mechanics, Vol 111, p 439-473, 1981. 18 Fig, 5 Tab, 23 Ref.

Descriptors: *Fluid mechanics, *Ice, Ice-water interfaces, Interfaces, Temperature effects, Salinity, Model studies, Flow, Laminar flow, *Boundry Layers, Flow characteristics.

The convection generated in the polar oceans when a freshwater ice wall melts in salt water of uniform far field temperature and salinity has been modeled in this experimental and theoretical study. The results show that there are three different flow regimes which depend on the temperature and salinity., First, when temperature and salinity lie between the maximum density curve and the freezing curve, the flow is only upward. Second, for the oceanic case where salinity lies between 30 and 35% and temperature is less than 20 degrees C, the flow consists of a laminar bidirectional flow at the bottom of the ice and a turbulent upward flow along the remainder of the ice wall. The laminar flow consists of an upward flowing layer about 2 mm thick inside of a downward flowing outer layer about 10 mm thick. Third, for the same salinity but for temperatures above 20 degree s C, the flow reverses. A laminar bidirectional flow occurs at the top of the ice above a downward turbulent flow. The governing equations were solved in similarity form with a spatially varying eddy diffusivity to model the turbulent upward flow theoretically. The spatially varying eddy diffusivity depends on the density difference between the ice/water interface and the far field. Data then allows the evaluation of the dependence of eddy diffusivity on temperature and salinity. The magnitude of the eddy diffusivity is of the same order as the molecular viscosity, and both mass injection at the interface and opposed bouyancy forces must be included in a realistic flow model. An intergral approach was used to predict the far field conditions that yield the high temperature flow reversal and obtain a result consistent with the observations. (Baker-FRC)
W82-05084

DISCHARGE CAPACITY OF LARGE STREAMS UNDER AN ICE COVER,
For primary bibliographic entry see Field 2E.
W82-05106

CONTROLLED NUCLEATION AND QUASI-ORDERED GROWTH OF ICE CRYSTALS FROM LOW TEMPERATURE ELECTROLYTE SOLUTIONS,
Lyon-1 Univ., Villeurbanne (France). Lab. de Physique des Materiaux.
J. Dupuy, J. F. Jal, C. Ferradou, P. Chieux, and A. F. Wright.
Nature (London), Vol 296, No 5853, p138-140, March 11, 1982.

Descriptors: *Ice formation, *Nucleation, Chemistry of precipitation, Precipitation, Chemical reactions, Ice, Ice crystals, Electrolytes, *Temperature effects, Controlled nucleation.

The crystallization of water was carried out in conditions where the growth is extremely slow and the nucleation events can be controlled. Slow nucleation conditions were obtained by choosing a concentration of water in an electrolyte solution such that the homogeneous nucleation temperature lay very close to the glass transition temperature. Solutions of 10.5 mo1% lithium chloride in deuterium oxide were prepared in controlled conditions to avoid the ingress of any light water. Samples of the solution were introduced into a 3-mm space between sapphire windows in a cell whose temperature could be manipulated by a controlled temperature block in which the cell was mounted. The block with cell was then suspended in a liquid helium cooled cryostat which provided the low temperature ambient for the temperature control system. Considering the mean separated crystallite size of 700 Angstroms, it was noted that the nucleation density at 139 degrees K must be a least 2,500 centers per cube micron, so high that the homogeneous nature of the nucleation phenomenon under study could not be doubted. A Guinier plot of the high Q side of the peak yields an average crystallite size for the small particles, after initial development at 140.4 K, of about 100 Angstroms. A maximum particle radium was determined of 220 Angostroms. An average radium of 100 Angostroms seems reasonable. The scattering cross section per mole of solution decreases rapidly with increasing concentration of LiC1. If the scattering power of ice initially formed from the supersaturated solution is weaker than that of the initial solution then, as the ice precipitates and residual solution concentrates, the contrast must pass through zero, giving a scattered intensity minimum. (Baker-FRC)
W82-05123

EVALUATION OF SNOWMELT FORECASTING METHODS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05552

SPECTRAL REFLECTANCES OF FRESHWATER ICE AND SNOW FROM 340 THROUGH 1100 NM,
S. J. Bolsenga.
PhD Thesis, 1981. 163 p, 59 Fig, 38 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-25073.

Descriptors: *Ice, *Ice cover, *Snow, Snow surveys, *Remote sensing, Computer programs, Prediction, *Spectral reflectance, Spectroradiometers, Great Lakes, Instrumentation.

A scanning, dual spectroradiometer system which simultaneously records incident and reflected flux in the 280-1100 nm range was developed for this study. In addition, two programs were written for data acquisition and storage that are compatible with a desk-top calculator. The assemblage represents a state-of-the-art system which can be used in the laboratory, where varying incident illumination or natural light might occur, as well as in the natural environment, where changes in incident flux cannot be controlled. Several devices were fabricated to protect the instruments in the natural environment. One of the most productive uses of the scans is in ice formation, growth and decay prediction using energy budget techniques. Knowledge of the spectral reflectances of each ice type should enable the energy budget modeler to calculate the overall spectral reflectances of an ice field by first determining the ice types and amounts present in the field and then by assigning the appropriate spectral reflectances to each ice type in proportion to its areal extent. The scans for snow have provided definite spectral signature information. It appears likely that a remote sensing plan, using an aircraft under overcast skies, could be developed to distinguish between snow and clear ice on the bases of detector output alone. Since the resolution of such a system would be high, shapes of the ice types could likely be observed. By combining shape with spectral reflectances, it is possible that groups of secondary ice types could be mapped. (Sinha - OEIS)
W82-05556

VELOCITY DISTRIBUTIONS UNDER FLOATING COVERS,
Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2E.
W82-05562

CONFIGURATION OF ICE IN FROZEN MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Colbeck.
Soil Science, Vol 133, No 2, p 116-123, February, 1982. 11 Fig, 9 Ref.

Descriptors: *Ice formation, *Crystal growth, *Frozen ground, Soil porosity, Ice-air interfaces, Pore water, Ground ice, Interstitial ice, Freezing.

Many different ice shapes and crystal distributions were detected by microscopic examination of 0.8 and 3 mm glass beads and silica sand, simulating different soils. Initial water content was 5%. Samples were examined soon after freezing and 10 months later. The air-ice interfaces were convex, and some pores were filled while others were not. Generally, small pores filled first. The variety in growth rates, nucleation sites, and local paths of heat and mass flow produced single and multicrystalline structures. Multi-crystals were common with the 3 mm glass beads, and single crystals were

more common in 0.8 mm glass beads. A variety of crystals were seen within a single sample. (Cassar-FRC)
W82-05615

DIRECT SNOW-WATER EQUIVALENT MEASUREMENTS BY AIR-BORNE GAMMA-RAY SPECTROMETRY,
Geological Survey of Canada, Ottawa (Ontario).
R. L. Grasty.
Journal of Hydrology, Vol 55, No 1/4, p 213-235, 1982. 10 Fig, 4 Tab, 23 Ref.

Descriptors: *Snow water equivalent, *Radioactivity techniques, Aircraft, Soil moisture, *Gamma radiation, Spectrometry, Potassium radioisotopes, *Remote sensing, Canada, *Ontario.

Snow water equivalent was measured by a technique that uses the buildup of scattered gamma-radiation from K40 with increasing snow water equivalent. This direct, single-flight airborne technique eliminates the problems associated with the standard two-flight technique, which requires soil moisture measurements, a pre-snow flight, and the same path for both flights. Variations in the gamma ray spectral shapes of K, U, and Th were determined on large concrete pads with known concentrations of the three radioelements using plywood sheets to simulate snow water equivalent layers. The airborne system was calibrated by flying over the Breckenridge and Lake Mead test areas, where radioactivity is well-documented, and converting the aircraft altitudes to an equivalent layer of water. Nine test flights over an area of unknown radioactivity 40 km southeast of Ottawa at altitudes of 90 to 210 meters gave results (141.9 + or - 13,9 mm) consistent with ground measurements of snow water equivalent (142 + or - 11 mm) and results from the two-flight method (139 + or - 1.4 mm). (Cassar-FRC)
W82-05643

EROSION FROM MOUNTAIN SNOWPACK MELT,
Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 2J.
W82-05664

WINTER HEAT BUDGET AND FRAZIL ICE PRODUCTION IN THE UPPER ST. LAWRENCE RIVER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, and R. W. Ruggles.
Water Resources Bulletin, Vol 18, No 2, p 251-257, April, 1982. 7 Fig, 10 Ref.

Descriptors: *Frazil ice, *Heat budget, *Ice formation, *St. Lawrence River, Rivers, Ice cover, Temperature effects, Heat transfer.

Winter heat budget and frazil ice production in the St. Lawrence River between the Ogdensburg-Prescott Boom and the Moses-Saunders Power Dam were analyzed. Heat budgets and spatial distribution of heat exchange rates were calculated for three winters. The most dominant factor in the heat budget was thermal energy contained in the flowing river water. In 1974-75, a warm winter, the ice-covered period was short, large open water areas existed, and water temperature was relatively warm. Surface heat loss was relatively large. Bed heat influx and frictional heating accounted for 18% and 2% of the total heat budget respectively. Frazil ice production was not extensive. In the average winter of 1977-78 ice cover was extensive. Although the total net heat exchange was small, frazil ice production in open water areas was large. During the cold winter of 1978-79 open water areas were greater than in 1977-78 and air temperatures were lower. Frazil ice production was extensive and formed a large hanging dam at Cardinal. Predictions that there should be less frazil ice production downstream of the Iroquois dam in 1978-79 than in 1977-78 were confirmed by field studies. (Cassar-FRC)
W82-05736

EFFECT OF ASHFALL ON SNOWMELT RATE AT PARADISE, MOUNT RAINIER, WASHINGTON,
University of Puget, Tocoma, WA. Dept. of Physics.
B. E. Brown.
Journal of Geophysical Research, Vol 87, No C2, p 1347-1350, February 20, 1982. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Snowmelt, *Volcanoes, Temperature effects, Thaw, Paradise, Mount Rainier, Washington, Geophysics.

Paradise, Mount Rainier, was the location of the only regularly reporting weather station receiving an ashfall from Mt. St. Helens which still had significant winter snowpack on the ground, making it possible to assess the effect of a layer of volcanic ash on a mountain snowpack. Paradise is located 74km north-northeast of Mt. St. Helens, at a bearing of 27 degrees east of north from the latter peak. Paradise received an ashfall of 0.0032 to 0.0064 meters on May 18, 1980. The ashfall was very effective in accelerating the melting of the spring snow cover. Similar effects on adjacent glaciers should have produced increased runoffs during the summer of 1980. The dark ash layer increased snowmelt by about 40% over the rate which would have been expected based on ambient temperatures. (Baker-FRC)
W82-05871

2D. Evaporation and Transpiration

A FLOODPLAIN STORAGE MODEL USED TO DETERMINE EVAPORATION LOSSES IN THE UPPER YOBE RIVER, NORTHERN NIGERIA,
CBA Engineering Ltd., Vancouver (British Columbia).
C. D. Sellars.
Journal of Hydrology, Vol 52, No 3/4, p 257-268, July, 1981. 5 Fig, 6 Ref.

Descriptors: *Flood plains, *Evaporation rate, *Water storage, Water loss, Mathematical models, Simulation analysis, Rivers, *Nigeria, *Upper Yobe River.

The Upper Yobe River system comprises the Hadejia and Jamaare Rivers, which rise in the Jos Plateau of northern Nigeria and combine in the lowlands upstream of the town of Gashua to form the Yobe River, which flows into Lake Chad. The catchments of these three rivers were studied to determine the most effective way of developing the water resources of the basin with emphasis on larger-scale water storage and irrigation development. The flow losses in the lowland area upstream of Gashua generally amount to about 70 percent of the total annual runoff from the upland area, while losses at lake Chad approach 90 percent. The annual flow regime is seasonal, with widespread flooding in the lowland areas where the rivers are multichannel and deltaic in nature. The storage effect resulting from the formation of large open water areas and swamps in the wet season causes flooding to continue into the dry season, when potential evaporation is at a maximum. The open-water and swamp evaporation losses could not be calculated directly due to the scarcity of data on the area flooded, which varies monthly and seasonally. A flood plain storage model was developed to simulate the changes in the flooded area with time on a monthly basis for 11 years of record. The open-water and swamp evaporation losses were found to comprise about 65 percent of the total annual losses, or about 45 percent of the total runoff. Other losses included an estimated 25 percent by evapotranspiration from the shallow groundwater table in the flood plain and about 10 percent by regional groundwater flow away from the flood plain. (Carroll-FRC)
W82-04863

EVAPORATION AT A HIGH ARCTIC SITE,
McMaster Univ., Hamilton, (Ontario). Dept. of Geography.
P. Marsh, W. R. Rouse, and M.-K. Woo.
Journal of Applied Meteorology, Vol 20, No 6, p 713-716, 1981. 3 Fig, 10 Ref.

Descriptors: *Arctic, *Evaporation rate, Polar regions, *Model studies, Soil water, Moisture, *Lysimeters, *Comparison studies.

This note attempts to define an empirical relationship between the alpha' parameter in Priestley and Taylor's version of the combination model and the surface soil moisture for a typical high arctic site. A comparison with the results obtained in other similar studies is also presented. The study was carried out about 5 km northeast of Resolute Airport, Northwest Territories. The dominant surface materials range from gravels to sandy loam. The climate is typical of the central Canadian High Arctic. The active layer deepens very rapidly as soon as the ground becomes bare of snow. To allow the direct measurement of evaporation small lysimeters were used which measured 13.8 cm in depth and 9.8 cm in diameter. The measured evaporation rates varied depending on the site of the lysimeter. For soil moisture volumes greater than 30% evaporation is large and proceeds near the potential rate. Between 30 and 20% there is a very rapid decrease in evaporation and below 20% it is very small. It was apparent from the study that there is no unique relationship between surface soil moisture and evaporation rates. The unvegetated high arctic soils are distinctive because it is the surace layer that must provide the water for evaporation, a major flux from deeper layers being unlikely due to the cold permfrost zone. As a result the evaporation rate falls rapidly as the soil surface dries. Most sites are distinctive, and under drying conditions the evaporation rate will be a response to the particular site characteristics. A generalized model is unlikely to be achieved. (Baker-FRC)
W82-04899

EVALUATION OF THE EFFECT OF LINEARIZATION OF THE MAGNUS EQUATION ON THE ACCURACY OF CALCULATING EVAPORATION FROM THE SURFACE OF MOIST SOIL AND TRANSPIRATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
E. A. Lozinskaya.
Water Resources, Vol 8, No 2, p 114-119, March-April, 1981. 3 Fig, 6 Ref. Translated from Vodnye Resursy, No 2, p 50-55, March-April, 1981.

Descriptors: *Soil-water-plant relationships, *Specific humidity, *Evapotranspiration, Magnus equation, Linear equation, Mathematical equations, Evaporation, Soil water, Transpiration, Humidity, Air temperature, Temperature, Vegetation effects.

The Magnus equation, one of four in a system used to calculate evaporation from the surface of moist soil, relates the saturated specific humidity of air to its temperature. Linearization of this equation produces less accurate results but clearly shows the relation between evaporation and various parameters of the problem. It is also more graphic and convenient for practical use. Errors introduced into the evaporation determination by linearization did not exceed 3% in typical cases and 8% in extreme cases. (Cassar-FRC)
W82-05031

EXECUTIVE SUMMARY FOR POWER PLANT COOLING SYSTEM WATER CONSUMPTION AND NONWATER IMPACT REPORTS.
United Engineers and Constructors, Inc., Philadelphia, PA.
M. C. Hu, G. F. Pavlenco, and G. A. Englesson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123474, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-112, September 1981. 19 p, 4 Fig, 9 Tab.

Descriptors: *Consumptive use, *Cooling water, *Cooling tower, *Powerplants, *Model studies, Cooling ponds, Water use, Industrial water, Evaporation, Saline water, Acid rain, Environmental effects, Air pollution.

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Three studies were performed by United Engineers and Constructors Inc... (UE and C) and Versar, Inc. to aid EPA in assessing water consumption and other nonwater quality environmental impacts of cooling systems used by the steam-electric generating industry. The two reports on water consumption agree that the Leung-Moore model satisfactorily predicts evaporation rates of evaporative cooling towers. Versar found that this model predicted evaporation rates of base-load plants within + or - 15 percent of material balance values based on plant data. UE and C addressed the Harbeck and Brady models for predicting evaporation rates from cooling ponds and (using available data) could not reach a definite conclusion on which model predicted evaporation more closely. Comparing predictions from five models, including the Harbeck and Brady models, Versar concluded that the Harbeck-Hughes and Meyer models predicted evaporation rates for five of six cooling ponds studied within + or - 15 percent of material balance values and appear suited to preliminary studies. UE and C conclude that limited data precluded general conclusions on drift effects from saltwater cooling towers, but that cooling tower drift and deposition apparently do not increase ambient salt loading to an extent that a significant impact has been observed or is expected. Similarly, the effect of wet cooling tower and stack plume interactions on acid rain formation and deposition could not be established from available information. (Moore-SRC)
W82-05067

INFLUENCE OF SEASONAL EVAPORATIVE DEMAND ON EVAPOTRANSPIRATION AND YIELD OF IRRIGATED WHEAT,
Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
I. K. Jaggi, and S. B. Sinha.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 891-895, December, 1981. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Irrigation, *Evapotranspiration, *Water use efficiency, Soil-water-plant relationships, *Wheat, Crop yield, Grain crops, *India.

Irrigated wheat (Triticum aestivum Linn. emend. Thell.) was grown in India during 2 successive winter seasons to determine the seasonal variations in extractable soil water in a meter profile, evapotranspiration, and evaporative losses from an open pan. Extractable soil water remained between 13 and 18 cm for the first 90 days in both seasons, indicating that the evapotranspiration needs of the wheat were largely met by irrigation or rainfall. By day 120 extractable soil water had reached less than 4 cm. The second season had less rainfall, slightly lower amounts of extractable soil water, and a greater open pan evaporation rate. Evapotranspiration was 35.9 cm in both seasons, of which 1/3 was contributed by profile-stored water. Open pan evaporation rates were 1 to 5 mm per day the first season and 2 to 8 mm per day the second season. Grain yields were 44.1 q per ha the first season and 40.2 q per ha the second, drier season. Water use efficiency (in q per ha per cm) was 1.23 the first season and 1.11 the second. On this vertisol the optimum yield of irrigated wheat may be predicted for a season with evapotranspiration/open pan loss ratios from 0.7 to 1.1. Serious yield reductions are likely at ratios below 0.6. (Cassar-FRC)
W82-05121

STABILITY EFFECTS ON GREAT LAKES EVAPORATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Derecki.
Journal of Great Lakes Research, Vol 7, No 4, p 357-362, 1981. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Lakes, *Evaporation, *Lake evaporation, Water loss, Great Lakes, Atmosphere, Atmospheric physics, Atmospheric pressure, Stability analysis, Mathematical studies, *Lake Erie, *Lake Superior, *Lake St Clair.

This paper summarizes air stability effects on evaporation for the highest and lowest Great Lakes in terms of evaporation, Lakes Superior and Erie, and also for a much smaller water body within the chain of Great Lakes, Lake St. Clair. Stability effects for the other, intermediate Great Lakes should fall between these extremes. The mass transfer method for computing evaporation is based on the removal of water vapor from the lake surface by turbulent diffusion. It is a function of the overlake wind speed and the vapor pressure difference between the saturated air at the lake surface and the ambient air at some predetermined level. The results indicated that atmospheric stability has to be considered for reliable mass transfer evaporation estimates from the Great Lakes. Seasonal variation in the mass transfer coefficient was seen to be of similar magnitude to that of the input data (wind, vapor pressure difference) or evaporation, and the use of constant coefficients cannot be justified. Winter ice-cover reduction of evaporation was seen to be perhaps as important as the stability effects on the input data or mass transfer coefficient and should be included for lakes with extensive ice cover. It was also noted that inclusion of the air stability-dependent mass transfer coefficient, land to lake data adjustment, and ice-cover effects during winter permits determination of realistic mass transfer operational evaporation estimates from readily available perimeter data. (Baker-FRC)
W82-05634

ESTIMATION OF ISOTOPIC EXCHANGE PARAMETERS, USING CONSTANT-FEED PANS,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, and F. W. Leaney.
Journal of Hydrology, Vol 55, No 1/4, p 151-161, 1982. 4 Fig, 2 Tab. 12 Ref.

Descriptors: *Evaporation pans, *Isotope studies, Water vapor, Humidity, Lakes, Measuring instruments, Isotope fractionation, Air-water interface, Evaporation.

Constant volume evaporation pans were used to estimate the isotopic composition of water evaporating from an open water body. There was close agreement between directly measured values and the values estimated from the pans for the isotopic composition of water vapor in the atmosphere and the relative humidity of the air normalized to the water surface temperature. To obtain annual data, separate experiments should be run for each 2-3 month period to avoid large climatic changes within the time scale of each experiment. This information is expected to be useful in water balance studies of open water bodies. (Cassar-FRC)
W82-05648

NEW EVAPOTRANSPIRATION CROP COEFFICIENTS,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W82-05692

A PREDICTION EQUATION FOR DAY NIGHT WIND RATIO CORRECTION ON REFERENCE CROP EVAPOTRANSPIRATION,
Marathwada Agricultural Univ., Parbhani (India).
G. R. Rao, S. L. Tate, and S. B. Varade.
Annals of Arid Zone, Vol 20, No 3, p 199-201, 1981. 2 Fig, 2 Ref.

Descriptors: *Evapotranspiration, *Semiarid lands, *Water requirements, Wind, *India, Penman equation, Monsoons.

Reference crop evapotranspiration (ET) values predicted by the modified Penman equation are corrected for day/night wind ratio under Indian conditions by the following equation: ETo = 0.969 + 0.812ETo*, where ETo and ETo* are the adjusted and unadjusted reference crop ET in mm per day, respectively. Unadjusted values (ETo*) are near to adjusted ET values after establishment of the southwest monsoon (late summer-fall), close or underpredicted in winter, and overpredicted in the premonsoon season (spring and early summer). The day/night wind ratio (range 1.1 to 3.8) is highest after establishment of the monsoon and lowest in the premonsoon season. (Cassar-FRC)
W82-05722

MEASUREMENT AND MODELLING OF PRIMARY PRODUCTION AND WATER USE IN A SOUTH TUNISIAN STEPPE,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
C. Floret, R. Pontanier, and S. Rambal.
Journal of Arid Environments, Vol 5, No 1, p 77-90, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Water use, *Steppes, Grasslands, Evaporation, Tunisia, Natural use, Model studies, Water resources development, Water supply development, Plant populations.

The effect of rainfall on above ground plant production was studied between 1971 and 1977 on a site consisting of steppeland on sandy soil, dominated by the perennial dwarf shrub Rhantherium suaveolens, with associated annual species. The average precipitation in this region was 180 mm, which produced about 1000 kg of dry matter/ha. A model was developed, ARFEJ, using the most pertinent characteristics of the system so that production could be predicted under the assumption that water is the limiting factor. Seven model coefficients were calculated with data from 1971-1975. The results of this study indicate that the effect of rainfall distribution on evaporation from bare soil is extensive. The mean of this evaporation was 55% of total evapotranspiration. During the short annual period of fast growth, the ratio of dry matter to water transpired would be about 1.26 g dry matter/kg water for annuals and 1.39 g dry matter/kg water for perennial species. Over the whole year, the average efficiency of water use was 0.45 g dry matter/kg water for all species. Above 250 mm of precipitation, the availability of nitrogen and/or phosphorus became the limiting factor for plant production, and efficiency of water use decreased. The accuracy of growth trends in general indicated that the model had considerable predictive value. It is therefore possible to calculate not only the dynamics of the phytomass of annual and perennial species, but also variations in soil water content. The model could help in range management by forecasting carrying capacity consistent with plant production, the quantity of fodder reserves needed and the time when they must be available. (Baker-FRC)
W82-05876

2E. Streamflow and Runoff

DOWNSTREAM REDUCTION OF RURAL CHANNEL SIZE WITH CONTRASTING URBAN EFFECTS IN SMALL COASTAL STREAMS OF SOUTHEASTERN AUSTRALIA,
Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson, and R. W. Young.
Journal of Hydrology, Vol 52, No 3/4, p 239-255, July, 1981. 32 Ref.

Descriptors: *Channel flow, *Coastal streams, Flood plains, Urban planning, Land use, Flood discharge, Alluvial channels, *Australia, *New South Wales, *Urban effects, Coastal streams, *Channel morphology.

Although the size of a river channel normally relates to the volume of water the channel must carry, streams flowing off the Illawarra escarpment in New South Wales, Australia, show a marked reduction of channel size accompanied by a downstream increase in flood frequency in their lower reaches. Bed and bank sediments are relatively coarse and uncohesive in the confined and steeply sloping valleys of the escarpment foothills, and channels increase in size in relation to increasing discharge downstream. However, there is a dramatic reduction in channel size as these streams emerge into the more open rural valleys at lower

slopes which are accompanied by extensive floodplains formed of fine cohesive sediment. The sudden decline in channel slope and associated stream power, the cohesive nature of the downstream alluvium, retention of the sediment on the channel banks by a dense cover of pasture grasses, and the availability of the extensive flood plain all contribute to the decrease in channel size. Floodwaters from these streams very frequently spill out over the floodplain, resulting in the reduction of the downstream channel flow to a relatively minor component of the total peak discharge. Stream channels formed in the fine alluvium rapidly entrench and increase in cross-sectional area by two to three times when urban development results in increased peak runoff and decreased effective floodplain area. This enlargement may be triggered by minor human-induced channel alteration and maintenance. (Carroll-FRC)
W82-04862

STABLE-CHANNEL DESIGN IN GRAVEL-BED RIVERS,
Ministry of Works and Development, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology, Vol 52, No 3/4, p 291-305, July, 1981. 2 Fig, 4 Tab, 27 Ref.

Descriptors: *River beds, *Gravel, *Stable channels, Mathematical equations, Particle size, Sediments, Sediment load, Mathematical models.

Regime relations are derived for more or less straight, stable, symmetrical, wide reaches of coarse gravel-bed rivers having low rates of bedload transport and at bankfull flow conditions. The relations are combined to express channel width as a function of median size of bed pavement, energy slope, and bankfull water discharge for sediment of constant specific gravity. This stable-channel design equation, together with three others of similar form in current usage, is tested for accuracy of channel with prediction with 60 field data sets from appropriate gravel-bed reaches. The minimum mean deviation of predicted width from the actual width prescribed in each data set was 160 percent, with a standard deviation of 430 percent. A dimensionless stability index, defined in terms of the above parameters, is deduced and shown to be remarkably constant in value at stable reach sections on particular gravel-bed rivers and for rivers within a single watershed. Employment of this index will result in a substantial improvement in the accuracy of stable-channel design. The range of application of the stability index method is increased by combination with an empirical equation that predicts median bed-pavement size from given flow conditions over gravel-bed material having a known initial sediment size distribution. An example of the suggested design procedure following from this combination is given for an existing unstable river-diversion channel. Some recommendations are made concerning the identification of stable river reaches and the determination of the requisite sediment parameters for design. (Author's abstract-FRC)
W82-04865

THE RELATIONSHIP BETWEEN FLOW-SHEAR STRESS AND STREAM PATTERN,
Geological Survey of Israel, Jerusalem.
Z. B. Begin.
Journal of Hydrology, Vol 52, No 3/4, p 307-319, July, 1981. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Shear stress, *Streams, *Stream profiles, Stream discharge, Braided streams, Data interpretation, Mathematical equations, *Hydrological regime, Geologic environment.

River channel patterns, whether straight, meandering, or braided, represent an equilibrium between hydrologic regime and geologic environment. Previous studies have shown that channel pattern is related to stream power, and therefore to hydraulic parameters which describe the flow in a more meaningful way than the mere specification of a certain combination of slope and discharge. The purpose of this study is to present a physical interpretation of the relationships depicted on a discharge-slope diagram which can be used to rationally differentiate between braided, straight, and meandering streams. Simple hydraulic reasoning is used to assign a 'relative shear-stress' value to each stream on the basis of a discharge-slope diagram for streams. A sample of 359 streams, ranging in mean annual discharge from 900,000 to 0.05 cubic feet per second and varying in pattern from highly sinuous to straight and braided, is sorted according to relative shear-stress values. Straight streams are produced by low-energy flow. Increases in energy, which are also increases in shear stress, result in bank erosion and meandering due to internal instability of the flow, which produces secondary currents. When an additional increase in flow energy results in such a high momentum that a different equilibrium is maintained between flow and bank sediments, the streams tend to have a greater radius of curvature of bends and to be less sinuous. A further increase in shear stress will result in such a high rate of bank erosion and sediment transport that braided channels form. The passage from one pattern to another within natural stream populations is gradual, since the geomorphic thresholds, defined by relative shear stress, tend to be fuzzy. (Carroll-FRC)
W82-04866

CYCLIC FLUCTUATIONS IN THE FLOOD AREA AND RELATIONSHIP WITH THE DOUBLE (HALE) SUNSPOT CYCLE,
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 2A.
W82-04896

A STUDY OF LOW-FLOW OPERATION OF MILFORD AND ELK CITY LAKES IN KANSAS,
Kansas Water Resources Research Inst., L Manhattan.
Y-S. Yu, E. C. Pogge, V. Knapp, and S. Esmaeil-Beik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224536, Price codes: A13 in paper copy, A01 in microfiche. Contribution No 217, October, 1980. 280 p, 75 Fig, 61 Tab, 62 Ref. OWRT B-053-KAN(1). 14-34-0001-8087.

Descriptors: *Streamflow, *Time series analysis, Lake evaporation, Mass-transfer method, Mathematical models, Reservoir operation, *Dynamic programming, Stochastic processer, Kansas, Elk River, Milford Lake, Low flow, Synthetic hydrology, Simulation analysis.

PART I -- The streamflow records at Elk City, Kansas, on the Elk River and at Clay Center, Kansas, on the Republican River have been analyzed to determine the seasonal means, standard deviations, correlation coefficients and skew coefficients. A first-order Markovian model has been developed for generating the synthetic streamflows. This model generates weekly and monthly streamflows, respectively, for the Elk River and the Republican River. The results indicate that taking the square root of the observed series prior to the application of the model produces the best overall agreement between the stochastic parameters of the synthetic streamflows and those of the observed streamflow series. PART II -- Weekly evaporations from the Milford and Elk City Lakes, respectively, were computed based on available climatological data, measured water temperature and the mass-transfer equation. The mean annual evaporations obtained from the weekly values for the Milford and Elk City Lakes are about 3% and 9%, respectively, greater than the values presented in the U. S. Weather Bureau Technical Report No. 37 (1959). The monthly pan coefficients obtained from this study are generally 5% higher than the pan coefficients used by the Kansas Water Resources Board (1974). Mathematical models for weekly evaporation were developed by the combined use of the Fourier approximations and an autoregressive model. The generated time series of the weekly evaporation closely matches the statistics of the weekly evaporation computed by the mass-transfer method. A sensitivity analysis was also made to determine the effect of variation of the model parameters on estimated evaporation and the change of evaporation per unit change of each input component of the mass-transfer equation. The results show that the mass-transfer model is most sensitive to changes in the water temperature. Part III -- A stochastic dynamic programming model has been developed and applied to determine the steady-state optimal policies for operating the conservation storages of Elk City and Milford Lakes, respectively. The model for the smaller Elk City Lake is based on Weekly net inflows calculated from the historical data while the model for the larger Milford Lake is based on monthly net inflows. The derived optimal policies are applied to operate the respective reservoir over a period of 10 years from 1967 through 1977. The results show that the developed algorithm is efficient in terms of both computer storage and time, attributable to the adaptation of a termination criterion based on the method of successive approximations. The results also show that adopting the optimal policies in operating the reservoir results in substantially less deviations from target storage than those shown in historical record.
W82-04964

DERIVATION OF HOMOGENEOUS STREAMFLOW RECORDS FOR THE GREEN RIVER BASIN, KENTUCKY,
Geological Survey, Doraville, GA. Water Resources Div.
T. W. Hale.
Geological Survey Open-File Report 79-1066 (WRI), 1979. 61 p, 39 Fig, 4 Tab, 5 Ref.

Descriptors: *Streamflow forecasting, Rivers, *Reservoirs, *Computer models, Simulation analysis, Hydrologic data, Low flow, Natural flow, Regulated flow, Routing, Reservoir operation, *Kentucky, *Green River basin.

Four flood-control reservoirs, Green River Lake, Nolin River Lake, Barren River Lake, and Rough River Lake, were completed in the Green River basin of Kentucky between 1959 and 1969. A digital computer model of these reservoirs and the stream reaches from the reservoirs downstream to the Green River at Calhoun, Ky., was developed to simulate mean daily streamflows. Simulations of 1941 through 1971 water year streamflows were made for both the pre-reservoir and post-reservoir basin conditions, thus supplying homogeneous data sets for low-flow analyses of eight stream sites. The 7-day, 10-year recurrence interval, minimum discharges of the simulated regulated flows exceed those of the simulated natural flows by about 30 cubic feet per second for the Barren River at Bowling Green, Ky., and about 260 cubic feet per second for the Green River at Calhous, Ky. Analyses of the pre-reservoir simulations show that, for seven of the stream sites, the model yields streamflow which have annual minimum 7-day average discharges that are not significantly different, at the 95 percent significance level, from those of the observed flows. Results of the post-reservoir simulations show that actual reservoir operation was not closely matched by the model. Therefore, the low-flow characteristics of the simulated regulated streamflows are merely estimates of those that could be expected if the basin were regulated according to the modeled reservoir operating criteria. (USGS)
W82-04979

BASE FLOW OF STREAMS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-79,
Geological Survey, Syosset, NY. Water Resources Div.
H. F. H. Ku, and D. L. Simmons.
Geological Survey Open-File Report 81-420 (WRI), 1981. 32 p, 1 Fig, 1 Plate, 3 Tab, 8 Ref.

Descriptors: *Streamflow, *Stream discharge, Data collections, Low flow, *Base flow, Flow characteristics, Flow measurement, Surface-groundwater relations, Aquifers, Seepage, Runoff, *New York, *Long Island, Nassau County.

South-shore streams on Long Island, N.Y., are small, widely spaced and have few or no tributaries. Their gradients are gentle, averaging 10 feet

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per mile. All streams in the area studied have a mean annual discharge of less than 20 cubic feet per second, and most are from 3 to 10 miles long. Under natural conditions, about 95 percent of total streamflow originates as ground-water seepage from the upper glacial aquifer; the remaining 5 percent consists of direct runoff. Thus, the streams of Long Island function as ground-water drains, the flow of which in dry weather is controlled directly by ground-water levels adjacent to the stream channels. Monthly low-flow discharge measurements of 18 south-shore streams in Nassau County from 1978-79 are tabulated in this report. Measurement sites were established at 1,000-foot intervals between the southern tide-affected reach and the northern headwaters of each stream. The measurements provide a data base for the 'Flow Augmentation Needs Study,' supported by the U.S. Environmental Protection Agency, which will evaluate the need to replace streamflow lost through lowering of the water table as a result of sewage in Nassau County Sewer Districts 2 and 3. (USGS)
W82-04980

NATURE OF WAVE ATTENUATION IN OPEN CHANNEL FLOW,
San Diego State Univ., CA.
V. M. Ponce.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 2, p 257-262, February, 1982. 5 Ref.

Descriptors: *Mathematical studies, *Open-channel flow, *Kinematic waves, *Waves, Wave action, Mathematical equations, Channel flow, Kinematic wave theory, Unsteady flow, Flow friction, Flow velocity, Channels, Wave velocity.

The mechanisms responsible for wave attenuation in open channel flow were studied in order to identify the term or group of terms which will cause a free-surface flow wave to dissipate. Linear stability theory was used to clarify the nature of wave attenuation in prismatic channels. Wave attenuation is shown to result from the interaction of the kinematic term (friction and bottom slope) with the local acceleration term. When local acceleration is neglected, wave attenuation may be attributed to the interaction of the kinematic term with the pressure gradient or convective acceleration terms or both. These findings may prove useful in the study of unsteady open channel flow. (Geiger-FRC)
W82-05003

NEW METHODS OF DESIGNING FLOOD CONTROL MEASURES,
A. V. Kozar, and Z. D. Romanyutina.
Water Resources, Vol 8, No 2, p 119-126, March-April, 1981. 2 Fig, 15 Ref. Translated from Vodnye Resursy, No 2, p 56-64, March-April, 1981.

Descriptors: *Flood control, *Reservoir releases, *Streamflow forecasting, Automation, Reservoir operation, Weather forecasting, Flood forecasting, *Stryi River, *USSR, Water storage, Control systems, Information systems, Water level recorders, Cloudbursts, Forecasting, Water management, Systems analysis, Precipitation, Rainfall-runoff relationships.

The flood control complex for the Stryi River, USSR, incorporates an automatic information measurement system for forecasting floods and controlling the hydrostation. High annual precipitation, 321 to 1301 mm, and summer cloudbursts cause catastrophic floods in this region. When heavy rainfall has been forecast, water is released from the reservoir at a rate which does not damage the downstream land. The automatic information measurement system consists of five subsystems: Short-range forecasting of rainfall floods, operative control of the hydrostation, analysis and monitoring of the control of the hydrostation, planning for multipurpose use of the water, and forecasting of water quality. Further refinements to the automated system are planned. A denser network of automatic observation posts will be installed, evaluated, and expanded if desirable. Forecasting is done by radar measurement of precipitation within a 100 km radius. This information is processed by the system to indicate the amount of moisture that fell on the drainage basin. Automated ground precipitation gages are used to double check the amount of precipitation. Water levels in the reservoir and at stream gaging stations are automatically measured. These measures are expected to reduce flood damages in this basin by 70%. (Cassar-FRC)
W82-05030

CONSEQUENCES AND RESPONSIBILITIES IN DROUGHT FORECASTING: THE CASE OF YAKIMA, 1977,
National Center for Atmospheric Research, Boulder, CO.
M. H. Glantz.
Water Resources Research, Vol 18, No 1, p 3-13, February, 1982. 5 Fig, 3 Tab, 51 Ref.

Descriptors: *Water allocation, *Forecasting, *Drought, *Yakima Valley, *Washington, Water supply, *Legal aspects, Political aspects, Social impact, Economic impact, Irrigation, Prediction, Water rights, Bureau of Reclamation, Streamflow forecasting, Weather modification, Columbia River basin.

In February 1977 the Bureau of Reclamation issued an erroneous forecast that during the coming irrigation season Yakima, Washington, irrigators would have an available water supply less than half of the average long-term supply. Those with senior water rights were to receive 98% of their normal water allocation; those with junior rights, 6% of their normal allocation. The forecast and allocations caused irrigation districts, farmers, and government agencies to undertake drought-inspired actions. These responses included buying and selling water rights at greatly inflated prices, constructing new wells at costs up to $250,000 each for a total of $9 million, proposing large-scale diversion projects, transplanting of mint and other perennials to the Columbia River Basin at personal expense, cloudseeding at a cost of $400,000 and complaints from states which felt their rainwater was being stolen, and implementing water conservation practices in farming. As the spring progressed it was evident that the forecast was not correct. Angry farmers started legal suits to recover some of the millions of dollars unnecessarily spent for drought protection. The primary forecasting error, since admitted by the Bureau, was a balancing out of return flow against some relatively minor diversions to other smaller irrigation projects. This should be done for flood control but not for water allocation. As a result of the fiasco the Bureau lost its credibility, built up since 1945. This raises the question of whether farmers will implement drought measures if the Bureau forecasts water shortages in the future. (Cassar-FRC)
W82-05082

BEND THEORY OF RIVER MEANDERS. PART 1. LINEAR DEVELOPMENT,
Saitama Univ. Urawa (Japan), Dept. of Foundation Engineering.
S. Ikeda, G. Parker, and K. Sawai.
Journal of Fluid Mechanics, Vol 112, p 363-377, 1981.

Descriptors: *Meanders, *Mathematical equations, Fluid mechanics, Rivers, Hydraulics, *Bank erosion, *Alluvial channels, Comparison studies.

In this analysis the heuristic model of Ikeda is used to develop a formal stability theory of channels with sinuous banks. Bank erosion is described, and the stability criterion is presented in terms of the growth rate of lateral bend amplitude. This aspect suggests the parlance of 'bend' theory, as opposed to the previously quoted 'bar' theories. The bend theory is applied to both the alluvial and incised cases. The linear theory herein yields a relation for initial characteristic bend wavelength that differs from that of Ikeda and shows much better agreement with data. A comparison with the predictions of one of the 'bar' theories indicates that, for alluvial streams, bar and bend instabilities operate at similar wavelengths when sinuosity is not too large. (Baker-FRC)
W82-05085

SEVERAL PLUME FLOWS IN PURE AND SALINE WATER AT ITS DENSITY EXTREMUM,
State Univ. of New York at Buffalo, Amherst. Dept. of Mechanical and Engineering Aerospace.
J. C. Mollendorf, R. S. Johnson, and B. Gebhart.
Journal of Fluid Mechanics, Vol 113, p 269-282, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Fluid mechanics, *Plumes, Flow, *Temperature effects, Salinity, Mathematical equations, Laminar flow, Physical properties, *Density, Density stratfication, Saline-freshwater interfacts.

This study is a similarity analysis of three constant-buoyancy plume flows in pure or saline water at its extremum temperature. Although the effect of saline diffusion is neglected, the influence of salinity level is retained. The analysis considers the only conditions for which a similarity solution is known for constant-buoyancy plume flows in cold unstratified water. The calculated results cover a wide range of Prandtl numbers and salinity and pressure levess. The three flow situations considered here are two above a horizontal line heat source and one above a point heat source. The first flow is a freely rising plane plume and the second is a wall plume (flow over a vertical, adiabatic surface with a horizontal line source imbedded in it). The third flow is the freely rising axisymmetric plume. These are the models in laminar theory of many processes which arise in cold water. The main purpose of the study was to calculate the effect of using a nonlinear density relation for water, which is much more accurate at low temperatures than the conventional linear one used in classical analyses. The downstream variations of the temperature and velocity fields were found to be very different from those for flows where the effect of a density extremum is not included. (Baker-FRC)
W82-05088

A NOTE ON THE STRUCTURE OF THE HEAD OF AN INTRUSIVE GRAVITY CURRENT,
Cambridge Univ. (England). Dept. of Engineering.
R. E. Britter, and J. E. Simpson.
Journal of Fluid Mechanics, Vol 112,p 459-466, 1981. 7 Fig, 17 Ref.

Descriptors: *Gravity studies, *Fluid mechanics, *Density currents, Water Currents, Plumes, Density, Interfaces, *Saline-freshwater interfaces.

In this note experiments are described in which the ratio of interface thickness to current depth and the ratio of current depth to the overall depth of fluid are systematically varied. The head of an intrusive flow advancing along the interface between two fluids is studied. The dependence of the flow on the interface thickness and the depth of the intrusion is determined. The tank used in the experimentation was 360 cm long by 20 cm wide and could be filled to a depth of 45 cm. It was filled to half the required depth with salt water and then tap water was carefully added to an equal depth above it. A partition was inserted 50 cm from one end, and the two fluids behind it were completely mixed. Removal of the partition released a current whose head was viewed throughout its journey by shadowgraph. The experiments show, at the smallest interfaces, clear Kelvin-Helmholtz billows, whose two-dimensional form is not broken up by any lobe and cleft structure as in boundary currents. When the interface thickness was less than 1/5 of the depth of the current, the behavior of the intrusive head approached that of a reflected inviscid current. This supports the conjecture that the results of Britter and SSimpson would be directly applicable to flows under a free surface. As the ratio of interface thickness to current depth increases, the Kelvin-Helmholtz billows were reduced in magnitude until mixing between the two fluids at the head ceases. When the interface thickness is comparable to the current depth the speed of second mode internal waves may be close to, or greater than, that of the intrusion and an interaction between the internal wave and the intrusive flow is noted. (Baker-FRC)
W82-05089

DISCHARGE CAPACITY OF LARGE STREAMS UNDER AN ICE COVER,
V. S. Altunin, E. G. Gladkov, and V. L. Ryabov.
Hydrotechnical Construction, Vol 15, No 6, p 329-335, June, 1981. 5 Fig, 3 Tab, 11 Ref. Translated from Gidrotektekhnicheskoe Stroitel'stvo, No 6, p 14-18, June, 1981.

Descriptors: *Ice cover, *Canal design, *Discharge capacity, Ice formation, *Flow velocity, Roughness coefficient, Rivers, Hydraulic structures, Hydraulic roughness, Design criteria, *USSR.

The effects of ice formation on the discharge capacity of large unlined canals (discharges of 500-1000 cu m per sec) were observed in several rivers in Russia during 1977-80. Equations were developed to describe the observations. Roughness coefficients do not remain constant during the ice period even in the absence of visible deformations of the canal bottom and in the presence of very small roughness projections on the lower ice surface. Mean velocity of flow has the greatest effect on the value of roughness coefficient. Rapid formation of an ice cover is desirable to minimize ice problems. Usually flow velocity is limited and average filling is maintained to encourage the formation of crystalline ice. Ice jams can be prevented by reducing releases and maintaining average filling. (Cassar-FRC)
W82-05106

DISEQUILIBRIUM PROFILE OF THE POTOMAC RIVER NEAR WASHINGTON, D.C. - A RESULT OF LOWERED BASE LEVEL OR QUATERNARY TECTONICS ALONG THE FALL LINE,
Geological Survey, Denver, CO.
J. C. Reed, Jr.
Geology, Vol 9, No 10, p 445-450, October, 1981. 4 Fig, 28 Ref.

Descriptors: *Tectonics, *Coastal plains, *Flow, *Stream profiles, Water level fluctuation, *Geologic formations, Profiles, *Sea level, Geologic time, Faults, Fall velocity, Rivers, Geological terraces, Stream beds, Tributaries, Bedrock, *Potomac River, Tributaries, Maryland, Virginia.

The long profiles of several major rivers in Maryland and Virginia are studied, and explanations for discontinuities near the Fall Line are sought. It is postulated that changes in base level during sea-level fluctuations in the Pleistocene were important contributors to discontinuities. Quarternary downcutting in response to a lowered base level may exlain the process. Strong circumstantial evidence suggests that the discontinuities in river profiles may be due to differential uplife of the Piedmont as well. However, terrace remnants at higher elevations are so dissected that correlations between remnants is impossible. Also, no fossils or radiometrically datable materials have been recovered from terraces above the Fall Line, and attempts to apply paleomagnetic techniques have yielded equivocal results. (Titus-FRC)
W82-05134

STOCHASTIC ANALYSES AND TRANSFER FUNCTIONS FOR FLOWS OF THE UPPER DELAWARE RIVER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
R. C. Ahlert, and B. M. Mehta.
Ecological Modelling, Vol 14, No 1, p 59-78, 1981. 5 Fig, 13 Tab, 10 Ref.

Descriptors: *Stochastic process, *Model studies, *Flow discharge, Water supply systems, Mathematical models, *Delaware River, Streamflow.

The use of stochastic modeling for description of regulated and unregulated flows and coupled flow networks is described, and application of this methodology to surface flows for the upper Delaware River and its tributary, the Lehigh River, is demonstrated. This type of modeling is possible only when data are available for extensive time periods and at relatively uniform intervals. Autoregressive integrated moving average (ARIMA) models have been synthesized to describe the random components of discharge time series. The effects of reservoir control on predictive flow models are examined in the context of combined deterministic-probabilistic models. Transfer functions have been developed to model the interaction between input and output data without a deterministic structure. Cross-correlation analysis has been used to describe the propagation of chance events throughout the system. (Carroll-FRC)
W82-05186

PLANKTON METABOLISM AND CARBON PROCESSES IN THE AMAZON RIVER, ITS TRIBUTARIES, AND FLOODPLAIN WATERS, PERU-BRAZIL, MAY-JUNE 1977,
Washington Univ., Seattle. Coll. of Fisheries.
For primary bibliographic entry see Field 2K.
W82-05197

HYDROLOGIC ANALYSIS OF PEARL RIVER FLOODS, APRIL 1979 AND APRIL 1980, IN LOUISIANA AND MISSISSIPPI,
Geological Survey, Baton Rouge, LA. Water Resources Div.
F. N. Lee, and G. J. Arcement.
Louisiana Department of Transportation and Development Research Study No 81-1-SS, 1981. 37 p, 40 Fig, 4 Tab, 19 Ref.

Descriptors: *Floods, *Flood peak, Precipitation, Streamflow, Runoff, Excess rainfall, Frequency analysis, *Flood data, Flood damage, Urbanization, *Louisiana, *Mississippi, *Pearl River.

Double-mass and trend curves of precipitation and streamflow data indicate that flooding in the Pearl River basin follows a natural, random pattern. The April 1979 flood was caused by excessive rainfall in the upper part of the basin where as much as 19.6 inches of rain fell in one storm. This caused the largest flood since 1901 in the Jackson, Miss. area, and the largest since 1938 in the Bogalusa, La. area. The Ross Barnett Reservoir, although generally not having a measurable effect on flood peaks in the Bogalusa area, may have dampened the peak discharge of the April 1979 flood in the Jackson, Miss., area by as much as 20%. The April 1980 flood was caused by excessive rainfall over the entire Pearl River basin, where precipitation amounts ranged from 8.6 to 15.0 inches. The coincidental timing of peak discharges of the Pearl River and the Bogue Chitto at their confluence caused a larger flood peak to occur near Slidell, La. than would be expected, based on the peak discharge recorded at Bogalusa, La. Land-use statistics indicate that about 4.8% of the basin is urbanized. Damage to urban property during the April 1980 flood amounted to about 12.75 million dollars in the Slidell area alone. (USGS)
W82-05216

FLOOD AND DEBRIS FLOOD HAZARDS MAP, CARSON CITY QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05217

STREAMFLOW CHARACTERISTICS OF THE UPPER COLUMBIA RIVER BASIN, MONTANA, THROUGH 1979,
Geological Survey, Helena, MT. Water Resources Div.
S. D. Waltemeyer, and R. R. Shields.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-185760, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-82, March 1982. 74 p, 1 Fig, 5 Ref.

Descriptors: *Streamflow, *Stream discharge, *Discharge frequency, *Data collections, Flow characteristics, Gaging stations, regulated flow, Low flow, Flow duration, Flood frequency, *Montana, *Upper Columbia River basin.

Statistical summaries of streamflow data for selected stream-gaging sites presented in this report aid in appraising the hydrology of the upper Columbia River basin in Montana. Streamflow records are provided for 54 gaging stations for the period of record. Streamflow records for five gaging stations were compiled into separate periods related to changes in regulation after data collection commenced. The entire period of record, the period before regulation, and the period after regulation are presented for comparison. For each gaging station selected for this report, a brief description is given for station location, drainage area, period of record, revisions of previously published records, type and history of gages, regulation and diversions, and extremes of discharge. These data are followed by tables of monthly and annual flow statistics, flood-frequency data, low-flow and high-flow frequency data, and flow-duration information. (USGS)
W82-05225

FLOODS OF SEPTEMBER 16, 1975 IN TALLABOA VALLEY, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 6F.
W82-05230

FLOOD OF JULY 1-5, 1978 ON THE KICKAPOO RIVER, SOUTHWESTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
P. E. Hughes, J. S. Hannuksela, and W. J. Danchuk.
Available from the Br. of Distr. 1200 S. Eads St. Arlington, VA 22202, Price: $14.00. Geological Survey Hydrologic Investigations Atlas HA-653, 1981. 7 Sheets, 7 Ref.

Descriptors: *Floods, *Flood damage, Precipitation, Storm runoff, *Flood discharge, Flash floods, Flood plains, Flood recurrence interval, Flood profiles, Aerial photographs, *Wisconsin, *Kickapoo River, Flood-plain delineation.

The Kickapoo River valley in southwestern Wisconsin had a devastating flood ($10 million estimated damages) during July 1-5, 1978. The flash flooding was caused by intense storms on June 30 through July 2. Total rainfall accumulation ranged from 5.8 inches near Ontario to 9.5 inches at La Farge. The resulting flood equaled or exceeded the largest ones recorded since the 1850's and equaled or exceeded the 100-year flood frequency at the U.S. Geological Survey's streamflow gages at La Farge and Steuben. Elevation and delineation of the flood are shown on photo mosaics developed from black and white aerial photographs. The 100-mile reach from Wauzeka to Wilton is shown. A summary of the storm conditions causing the flood and an analysis of the rainfall totals, as prepared by the Wisconsin Geological and Natural History Survey, are also included. (USGS)
W82-05236

STREAM-AQUIFER INFLUENCE COEFFICIENTS AS TOOLS FOR SIMULATION AND MANAGEMENT,
Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 2F.
W82-05346

ON MEASURING TIME-AVERAGED VELOCITIES IN OPEN CHANNEL FLOW,
Copenhagen Univ. (Denmark). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-05462

FLOOD PEAK REGIONALIZATION USING MIXED-MODE ESTIMATION OF THE PARAMETERS OF THE LOG-NORMAL DISTRIBUTION,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. L. Shrader, W. J. Rawls, W. M. Snyder, and R. H. McCuen.
Journal of Hydrology, Vol 52, No 3/4, p 229-237, July, 1981. 1 Fig, 3 Tab, 9 Ref.

LIBRARY U. OF I., URBANA-CHAMPAIGN

Descriptors: *Flood peak, *Estimating equations, Prediction, Mathematical equations, Regional analysis.

Most hydrologic design problems occur at sites for which stream-gage data are not available. Either an uncalibrated estimation method or an empirical equation based on a regionalization of peak discharge estimates from gaged data must be used for the ungaged locations. Traditionally, empirical equations have been calibrated by regressing estimated peak discharges, which have been obtained from a log-Pearson Type-III analysis of gaged data, on watershed and precipitation characteristics. Although this method is sensitive to both extreme events and small sample sizes, problems, a particular form of the three-parameter log-normal distribution has been developed by utilizing a variate transform of the annual peak-flow series for fitting to a histogram. This mixed-mode fitting uses nonlinear least squares to optimize on the class errors between the observed and computed histograms of the data. A fixed probability range is used to control the sample variability. The mixed-mode estimator technique and the traditional technique were each used to derive parameters for 132 goage sites in Pennsylvania. Peak discharges of five different exceedance probabilities were then computed for each station and regionalized for use at ungaged sites. Regression techniques were used to relate the peak discharges to watershed and precipitation characteristics; drainage area was the only predictor variable that was necessary for accurate estimates. The average error for the mixed-mode log-normal method did not differ significantly from the log-Pearson Type-III regionalization equation error, although the range of the correlation coefficients was slightly smaller for the mixed-mode method. (Carroll-FRC)
W82-05495

THE PROPERTIES OF THE KERNELS OF THE VOLTERRA SERIES DESCRIBING FLOW DEVIATIONS FROM A STEADY STATE IN AN OPEN CHANNEL,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and W. G. Strupczewski.
Journal of Hydrology, Vol 52, No 3/4, p 185-198, July, 1981. 5 Fig, 10 Ref.

Descriptors: *Flow characteristics, *Mathematical models, *Open channels, Channel flow, Mathematical equations, Unsteady flow.

The modeling of the deviations of the flow from the steady state in an open channel by the Volterra series is discussed. A non-linear state equation is used to derive analytically the kernels of the Volterra series. The results of the modeling presented in this paper demonstrate the effect of the type of input signal on the accuracy of approximmation of the nonlinear state equation that describes the flow deviations from a steady state by means of the integral Volterra series. The simulation of the inflow deviations from a steady state was carried out for a channel with the length five times longer than the characteristic reach. The Runge-Kutta method was used to solve the complete nonlinear set of differential equations numerically. The standard IBM procedure, in which the step of integration is chosen automatically for an imposed computational accuracy was used. Inflows of the form of rectangular pulses with different duration andd amplitude were taken as input signals. The linear and quadratic approximation for the analyzed inflows were determined. It is suggested that determination of the structure of the kernels in such a way that the convergence can be examined may be a decisive factor in further application of the Volterra series to modelling and identification of hydrological systems. (Carroll-FRC)
W82-05525

VELOCITY DISTRIBUTIONS UNDER FLOATING COVERS,
Canada Center for Inland Waters, Burlington (Ontario).
Y. L. Lau.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 76-83, 1982. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Velocity distribution, *Floating ice, *Streamflow, Velocity, Ice, Mathematical equations, Stream gages, Ice cover, Model studies, Turbulence.

The turbulence model was used to calculate the velocity distributions for a large number of stream flows under a variety of conditions. The results are used to review the stream gaging procedure and to examine some of the flow properties that are important in the development of many of the equations for ice-covered flow. The computed velocity distributions show that the velocity profiles are logarithmic only for about 60% of the layer thickness. For the 40% of the flow near the location of maximum velocity, the velocities are less than those given by the logarithmic distribution. The velocities at 0.2 and 0.8 of the depth may deviate significantly from the overall average velocity. However, the differences seem to compensate for each other, and the average of these two velocities is only about 2% higher than the actual mean velocity for most of the flows considered. When the depth is small and the velocity has to be measured at mid-depth, the correction needed to obtain the mean velocity can be 5% larger or smaller than the value of 0.88 generally used. The distance to the point of maximum velocity or the thickness of the rougher layer increases as the difference in the roughness of the boundaries increases. For fully rough flow, this thickness is almost independent of the relative roughness. However, when one boundary is smooth or when the flow near the boundary is not fully rough, both the Reynolds number and relative roughness can have an appreciable effect. (Baker-FRC)
W82-05562

INVESTIGATIONS OF CATASTROPHIC MAXIMUM DISCHARGES OF THE ARAKS RIVER,
G. T. Trembovel'skii.
Hydrotechnical Construction, Vol 15, No 7, p 423-427, 1981. 2 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 30-32, July, 1981.

Descriptors: *Flood frequency, *Peak discharge, *Historic floods, Araks River, Euphrates River, USSR, Flood discharge, Streamflow, Rivers, Discharge frequency, Statistical analysis, Flood recurrence interval.

Historical discharge data for the Araks River, USSR, were analyzed. During 1912-1968 maximum discharges at the Karadonly basin outlet were 240-1700 cu m per sec. The May 7, 1969, flood discharge was 2700 cu m per sec., classed as catastrophic and of quite rare frequency. Data indicated that the 1969 discharge was not exceeded at least since 1888. Prior to that date floods occurred in 1868, 1850, and 1828, for which only descriptions are available. However, it is believed that these floods also did not exceed the 1969 event. Considering the synchronism of the Araks with the Euphrates, it may be assumed that a high flood occurred on the Araks in 1174. The Khudaferin bridge on the Araks, constructed in the 12-13th centuries, has a discharge capacity of 3140 cu m per sec. Distribution curves of maximum discharge were prepared by several different statistical methods and for four reference stations on the river. The best estimates of distribution parameters were obtained by the maximum likelihood method. Maximum discharges calculated by the method of moments with the 91-year series, and by Monte Carlo, Humbel, and graphico-analytical methods using the 53 and 60 year series were underestimated. (Cassar-FRC)
W82-05591

EFFECT OF THE SPRING FLOOD REGIME ON THE DEVELOPMENT OF NORTH CASPLAN ZOOBENTHOS,
Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
V. F. Osadchykh.
Hydrobiological Journal, Vol 16, No 6, p 17-24, 1980. 10 Fig, 5 Tab, 18 Ref.

Descriptors: *Benthic fauna, *Floodwater, *Biomass, Rivers, Streamflow, Aquatic animals, Volga River, Caspian Sea, Fish food organisms, Rising stage, Invertebrates, Productivity, Water management, Flow duration, Lakes.

The effects of the Volga River spring flood on living organisms in the North Caspian Sea were studied from 1956 to 1973. Benthic biomass was significantly correlated with flood characteristics such as volume of discharge for the flood period, date in April of the beginning of the flood, duration of rise of flood waters, duration of flooding, and rate of rise of the flood. The highest benthic biomasses (>80 g per sq m) occurred with spring floods of 120-140 cu km beginning in early April, with 75-80 days of flood water rise at a rate of 2-3 cm per day or less and a total flood duration of 100-110 days. Low benthic biomasses (30 g per sq m) were found with low flood volumes (66 cu km) beginning in May, with a rapid rise (9-10 cm per day) of short duration (30-35 days). It is important that these relationships be used as a whole, and not selectively, in optimizing water releases into the lower Volga River. (Cassar-FRC)
W82-05596

PRELIMINARY MODEL OF AN URBAN FLOODPLAIN UNDER CHANGING LAND USE,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 4C.
W82-05642

A PARAMETRIC MODEL TO ESTIMATE RUNOFF FROM SMALL AGRICULTURAL WATERSHEDS IN THE SEMI-ARID TROPICS,
International Crops Research Inst. for the Semi-Arid Tropics, Patacheru (India).
J. H. Krishna.
Journal of Hydrology, Vol 55, No 1/4, p 43-51, 1982. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Agricultural watersheds, *Surface runoff, *Land management, Rainfall-runoff relations, Parametric hydrology, Runoff, Model studies, Cropland, Semiarid lands, Vertisols, Hydrologic budget, Soil water, Evapotranspiration, Texas, India(Hyderabad).

A parametric water balance model (RUNMOD) was developed from hydrologic data collected from small semiarid tropical agricultural watersheds with Vertisols. Watersheds were located in Hyderabad, India, and in Texas. Individual storm runoff volumes were satisfactorily predicted, especially when good data were used for the high intensity, short duration storms. The model was also used to predict evapotranspiration and soil moisture. The model operates with limited input and helps in evaluation of the effects of different land management practices on rainfall utilization for crop production. (Cassar-FRC)
W82-05646

BEND THEORY OF RIVER MEANDERS. PART 2, NONLINEAR DEFORMATION OF FINITE-AMPLITUDE BENDS,
Minnesota Univ., Minneapolis, St. Anthony Falls Hydraulic Lab.
G. Parker, K. Sawai, and S. Ikeda.
Journal of Fluid Mechanics, Vl 115, p 303-314, 1982. 6 Fig, 5 Ref.

Descriptors: *Meanders, *Rivers, Mathematical studies, *Mathematical equations, *River mechanics, Statistical analysis, Alluvial channels, River beds, Channel accretion, Channel erosion, Equations.

In this paper a generalized nonlinear equation of bend migration is treated, based on a analysis in an earlier paper. An expansion technique reminiscent of the Stokes expansion for water waves is developed to perform a nonlinear stability analysis. This analysis provides an explanation of skewing and fattening, and also indicates that lateral and downstream migration rates should increase as bend amplitude develops. The analysis predicts the following nonlinear effects on bend development: reduction in lateral and downstream migration rates

below the values predicted by the linear theory; the development of positive fattening and skewing; and an increase in characteristic meander wavelength for the case of alluvial meanders. (Baker-FRC)
W82-05651

STORM RUNOFF FROM SMALL LOWLAND CATCHMENTS IN SOUTHWEST ENGLAND,
Imperial College of Science and Technology, London (England).
For primary bibliographic entry see Field 4C.
W82-05653

THREE-STATE MARKOV MODEL FOR DIFFERENTIAL PERSISTENCE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
M. Bayazit.
Journal of Hydrology, Vol 55, No 1/4, p 339-346, 1982. 2 Fig, 7 Ref.

Descriptors: *Streamflow forecasting, *Markov processes, Rivers, Low flow, High flow, Model studies, Mathematical models.

Annual flows of some rivers exhibit differential persistence in that low flows are more persistent than high flows. A mathematical model for such flows is described, which is a three-state Markov model. States of the Markov process are defined as low, normal and high flows with respect to a lower and an upper truncation level. In the simulation of annual streamflows using this model a sequence of flow states is generated to start with, and then actual flow values are produced by means of a Markov model. This model preserves mean, variance, covariance, positive and negative run-lengths of observed flows. Charts are given to determine the values of the autocorrelation coefficient of the model. The proposed model is applied to the simulation of annual flows of a river exhibiting differential persistence, and it is found that it can satisfactorily represent the process. (Author's abstract)
W82-05654

TIME AND FREQUENCY DOMAIN ANALYSES OF HYDROLOGICAL SYSTEMS,
Federal Inst. of Hydrology, Coblenz (Germany F.R.).
G. Huthmann, and K. Wilke.
Journal of Hydrology, Vol 55, No 1/4, p 347-369, 1982. 10 Fig, 2 Tab, 20 Ref.

Descriptors: *Input-output analysis, *Streamflow forecasting, *Hydrologic models, *Discharge hydrographs, Rivers, *Rhine River, Nahe River, Tributaries, Forecasting, Simulation analysis, Model studies, Mathematical models, Multichannel filtering method, *Multiple frequency response analysis.

Two recently developed multiple input-single output (MISO) models were compared in an analysis of high flows of a 47.9 km Rhine River reach where discharge behavior is affected by a tributary, the Nahe River. The Wiener multichannel filtering method, used in the time domain, and multiple frequency response analysis, used in the frequency domain, were analyzed mathematically in detail. Discharge records of high flow events from 1957 to 1966 on the Rhine were used as input. Forecasting was done for the period February 4-25, 1966, and compared with observed data. There were no statistically significant differences between results from both methods. There was good agreement with recorded observations. (Cassar-FRC)
W82-05655

MULTI-DECISION ANALYSIS FOR LARGE-SCALE RIVER-BASIN RESERVOIR SYSTEMS,
Little (Arthur D.), Inc., Cambridge, MA.
M. Bonazountas, and J. M. Camboulives.
Journal of Hydrology, Vl 51, No 1-4, p 139-149, May, 1981. 5 Fig, 11 Ref.

Descriptors: *River basin development, *Reservoir design, Mathematical studies, *Optimization, *Optimum development plans, Reservoir operation, Flood control, Water quality control.

In order to achieve the potential benefits of river basin management, it is necessary to construct a variety of reservoirs or other secondary facilities, which must be planned and operated according to several optimization rules, and to specify a variety of objectives. Although there have been many studies of flood control, there are no examples of research on flood and water quality control for large-scale reservoir systems where the adaptive predictor for the reservoir releases is strongly influenced by that of the subsystems. A method is proposed for optimizing problems of conjunctive operation of large-scale multipurpose reservoir systems. The problem specifies three different objectives for the immediate operation of the entire system. As a result, the analysis must include formulation of an on-line optimization problem for as long as the flood lasts, of a long-term optimization problem, and of a flood-water quality problem and a search for the overall optimal policy for the entire system. Discrete dynamic programming and linear and mixed integer programming are used in the model. The overall hierarchical optimization is formulated by using the goal-coordinating method and a numerical iterative solution with two levels. Application of this method to the specified problem demonstrates the feasibility of using decomposition techniques in the search for overall optima regarding flood and water quality river control for large-scale reservoir systems. However, the solvability of the problem will depend largely on the solvability of the decomposed models and on the capability to identify saddle point conditions for the decomposed optimization. (Carroll-FRC)
W82-05659

DISPERSION IN TUMBLING FLOW,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 8B.
W82-05796

FLOW RESISTANCE IN WIDE RECTANGULAR CHANNELS,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05798

FLOOD OF APRIL 12-13, 1979 IN TUSCALOOSA AND NORTHPORT, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. R. Harkins.
Geological Survey Open-File Report 81-1057 (WRI), 1980. 1 Sheet, 15 Fig, 2 Tab, 3 Ref.

Descriptors: *Floods, *Storms, *Runoff, *Flood damage, Rainfall intensity, Streams, Flood peak, High water mark, Flood frequency, Flood recurrence interval, Historic flood, Flood plains, Flood hydrographs, *Alabama, Tuscaloosa, Northport, Black Warrior River.

The April 12-13, 1979, storm produced record flooding on the Black Warrior River at Tuscaloosa and Northport, Ala. The peak discharge exceeded the 100-year flood at the U.S. Geological Survey gaging station at Northport. Small streams in the urban areas had floods of approximately 10-year recurrence intervals. Rainfall of 9.0 inches for 24 hours ending 8:00 a.m. April 13 was equivalent to the 100-year rainfall-frequency intensity for Tuscaloosa. Flood peak elevations caused by the April 12-13, 1979, storm were determined from high water marks along streams in Tuscaloosa and Northport. These peaks are compared to historic peaks at gaging stations. The flood peak discharge on the Black Warrior River at Northport exceeded the maximum known flood of April 1900. However, the flood peak of the April 13, 1979, flow was of a lower elevation because of changes in the flood plain. (USGS)
W82-05824

RIVER PLUME STUDIES IN DISTORTED FROUDE MODELS,
Norwegian Hydrodynamical Labs., Trondheim. River and Harbour Lab. Div.
T. A. McClimans, and S. Saegrov.
Journal of Hydraulic Research, Vol 20, No 1, p 15-27, 1982. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *River flow, *Plumes, Mathematical studies, Mixing, Destratification, Salinity, Mathematical models, Model studies, Froude number, Fjords, Orkla River, Surface tension, Simulation, Laboratory studies, Hydraulic models.

A laboratory study was performed of a river discharge to a stratified receiving basin to control a conjecture that mixing occurs predominantly in a frontal region in the absence of wind and tidal currents. Buoyant surface discharges with a densimetric Froude number of about 1 and various aspect ratios were studies in a simulated fjord basin with a seaward narrows. The results demonstrated that river plume entrainment can be simulated accurately in distorted Froude models so long as the aspect ratio of width to depth is greater than 10 in the laboratory, provided that the depth was greater than 1 centimeter for salinity stratification and greater than 4 centimeters for thermal stratification. These present results fill in some of the details regarding Haggstrom's work and extend the physics to a stratified receiving body. The hypothesis of frontal mixing was supported by the findings. (Baker-FRC)
W82-05864

FLOOD DAMAGE ASSESSMENT AND FLOOD CONTROL PLANNING AS PART AND PARCEL OF THE ECONOMICS OF WATER UTILIZATION (VLOEDSKADEBEPALING EN VLOEDSKADEBEHEER AS ONDERDELE VAN DIE EKONOMIE VAN WATERBENUTTING),
Orange Free State Univ., Bloemfontein (South Africa).
For primary bibliographic entry see Field 6A.
W82-05896

2F. Groundwater

A DERIVATION OF THE EQUATIONS FOR TRANSPORT OF LIQUID AND HEAT IN THREE DIMENSIONS IN A FRACTURED POROUS MEDIUM,
Cold Regions Research and Engineering Lab., Hanover, NH.
K. O'Neill, and G. F. Pinder.
Advances in Water Resources, Vol 4, No 4, p 150-164, December, 1981. 2 Fig, 65 Ref.

Descriptors: *Geothermal studies, *Porous media, *Heat transfer, Mass transfer, Heat flow, Equations, Model studies, Fracture permeability, *Groundwater movement, Groundwater flow, Pore water.

Equations are derived for the transient, three-dimensional transport of heat and mass in compressible, liquid saturated, fractured porous media. Single component thermochemical transport equations are applied to each point in the microscopic medium and are transformed to produce analogous equations in terms of variables which pertain to the scale of observation. Chemical reactions and species transport are ignored. The equations are reduced to a set of coupled, non-linear partial differential equations, which can be solved by numerical methods. The primary purpose of this study was to develop a model for simulating naturally fractured geothermal reservoirs, particularly hydrothermal reservoirs under exploitation. The equations may also be applied to underground heat storage problems, process analysis, species transport, and waste disposal problems. (Cassar-FRC)
W82-04888

LINEBORO QUADRANGLE: HYDROGEOLOGY,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04969

LIBRARY U. OF I., URBANA-CHAMPAIGN

HYDROLOGIC DATA OF THE SHAWSHEEN RIVER BASIN, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04970

GROUNDWATER RESOURCES OF THE WILLIAMSPORT REGION, LYCOMING COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
O. B. Lloyd, Jr., and L. D. Carswell.
Available from State Book Store P.O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resource Report 51, 1981. 69 p, 5 Fig, 2 Plates, 14 Tab, 13 Ref.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, *Wells, Well data, Water yield, Groundwater movement, Water properties, Geohydrology, Water quality, Chemical analysis, Groundwater availability, Maps, *Pennsylvania, *Lycoming County, Williamsport region.

The aquifers that form the groundwater reservoir in the Williamsport region are composed of consolidated fractured rocks and overlying unconsolidated deposits. The fractured rocks consist of carbonate rocks, shale, siltstone, and sandstone that range in age from Ordovician to Pennsylvania. The unconsolidated deposits are Quarternary in age. The average yield of wells located and constructed for high yield is about 300 gallons per minute from unconsolidated deposits, 200 gallons per minute from carbonate rocks, 150 gallons per minute from sandstone, 100 gallons per minute from shale, and 75 gallons per minute from siltstone. The maximum yields that have been obtained range from 2.5 to 10 times these amounts. Typically, water from the carbonate rocks has a pH of 7.0, is very hard (200 milligrams per liter), and has about 450 milligrams per liter dissolved solids. Water from the noncarbonate rocks generally has a pH of 6.9, is moderately hard (85 milligrams per liter), and has about 150 milligrams per liter dissolved solids. Concentrations in excess of the Environmental Protection Agency standards for iron, manganese, sulfate, chloride, dissolved solids, hydrogen sulfide, barium, cadmium, lead, nitrate, and zinc are found locally. (USGS)
W82-04971

GROUNDWATER AND GEOLOGY OF THE CUMBERLAND VALLEY, CUMBERLAND COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div., and Esso Prospeccao Limitada, Rio de Janeiro, Brazil.
A. E. Becher, and S. I. Root.
Available from State Book Store, P. O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resource Report 50, 1981. 94 p, 14 Fig, 3 Plates, 14 Tab, 51 Ref, Append.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, Wells, Well data, Geohydrology, Water use, Water demand, Specific yield, Transmissivity, Hydrologic budget, Water quality, Chemical analysis, Water analysis, Trace elements, Contamination, *Pennsylvania, *Cumberland County, Cumberland Valley.

Demands on water resources of the northern part of the cumberland valley have increased 70 percent in the 15 years since 1960. Total use in 1975 was about 25 million gallons per day. Data from 650 wells, 30 springs, 106 chemical and 50 coliform-bacteria analyses indicate the intensely deformed rocks can provide abundant good quality water. The median, sustained yields in gallons per minute, calculated from specific capacity data of the carbonate rocks are Tomstown, 1000; Waynesboro, 170; Elbrook, 220; Zullinger, 82; Shadygrove, 26; Stonehenge, 57; Rockdale Run, 400; St. Paul, 82; Chambersburg, 11; and in shale of the Martinsburg formation, 28. In preferred locations such as valleys or on fracture trace, wells in the carbonate aquifer may produce 2000 gallons per minute, Colluvium on the flank of South Mountain provides extra storage for the carbonate aquifer, reduces ground-water level fluctuations, lowers flood peaks, and increases flow in the Yellow Breeches Creek during drought. Joints, faults, solution enlarged openings and variations in lithology control the occurrence and movement of water. A north-south diabase dike acta as a subsurface dam. Losses from the Yellow Breeches to the Conodoguinet basin average 9000 gallons per minute. The water is hard. Moderate levels of nitrate occur in the carbonate aquifer. Iron and hydrogen sulfide are common in the Martinsburg. Flooding of subsurface structures and increasing chemical and bacterial contamination are the major problems. (USGS)
W82-04972

GROUNDWATER RESOURCES OF THE GETTYSBURG AND HAMMER CREEK FORMATIONS, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
C. R. Wood.
Available from State Book Store, P. O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resources Report 49, 1980. 87 p, 4 fig, 2 Plates, 17 tab, 62 Ref.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, *Wells, Well data, Springs, Water level, Water yield, Groundwater availability, Water use, Groundwater recharge, Pumping, Drawdown, Groundwater movement, Geohydrology, Water quality, Water pollution, Water analysis, Maps, *Pennsylvania, *Gettysburg Formation, *Hammer Creek formation.

The area of investigation is in southeastern Pennsylvania and is underlain by sandstone, shale, and conglomerate of the Gettysburg and Hammer Creek formations and by diabase dikes and sills. In 1976, about 6 million gallons per day of water was obtained from wells and springs for all uses except domestic and stock, but possibly as much as 144 million gallons per day could be pumped from the entire area. Ground water in the study area is chiefly of the calcium bicarbonate type, and its chemical quality is generally good. Most ground water occurs in and moves through very narrow bedding planes and joints. These openings, which close with depth, are developed only in a few thin beds. Median yields of nondomestic wells are 110, 85, and 6 gallons per minute in the Hammer Creek Formation, Gettysburg Formation, and diabase, respectively. Median specific capacities of nondomestic wells are 1.2, 1.0, and 0.07 gallons per minute per foot of drawdown for these same units. Nondomestic wells show little uniform relationship between specific capacity and topographic position, suggesting that water-yielding zones are no more abundant or permeable beneath valleys than beneath other topographic settings. (USGS)
W82-04973

HYDROGEOLOGIC DATA COLLECTED FROM THE KISSIMMEE PLANNING AREA, SOUTH FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04974

SINKHOLE DEVELOPMENT RESULTING FROM GROUND-WATER WITHDRAWAL IN THE TAMPA AREA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-185141, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-50, 1982. 19 p, 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Sinks, *Karst, Aquifer characteristics, *Wells, Pumping, Groundwater level, Carbonate rocks, Limestone, Subsidence, *Florida, *Tampa, Floridan aquifer, Sinkholes, *Drawdown.

The area of municipal well fields on the Gulf Coastal Plain north of tampa, Fla., is densely pitted with natural sinkholes and sinkhole lakes that have resulted from collapse of surficial sand and clay into solution cavities in the underlying carbonate rocks of the Floridan aquifer. Although solution of the underlying rocks is the ultimate cause of sinkholes, some have been induced by abrupt changes in ground-water levels caused by pumping. Declines in water levels cause loss of support to the bedrock roofs over cavities and to surficial material overlying openings in the top of bedrock. The volume of calcium, magnesium, and carbonate (the constituents of limestone and dolomite) in solution in the water withdrawn from four well fields near Tampa totaled about 240,000 cubic feet in 1978. Most induced solution takes place at the limestone surface however, and the area of induced recharge is so extensive that the effect of induced limestone solution on sinkhole development is negligible. Alinement of established sinkholes along joint patterns in the bedrock suggests that a well along these lineations might have direct hydraulic connection with a zone of incipient sinkholes. Therefore, pumping of large-capacity wells along such lineations would increase the probability of sinkhole development. Although sinkholes generally form abruptly in the study area, local changes such as vegetative stress, ponding of rainfall, misalinement of structures, and turbidity in well water are all indications that percollapse subsidence may be taking place. (USGS)
W82-04982

LITTLETOWN QUADRANGLE: HYDROGEOLOGY,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04984

GROUND-WATER HYDROLOGY OF JEFFERSON COUNTY, WEST VIRGINIA,
Geological Survey, Morgantown, WV. Water Resources Div.
W. A. Hobba, Jr.
West Virginia Geological and Economic Survey Environmental Geology Bulletin EGB-16, 1981. 21 p 11 Ref.

Descriptors: *Groundwater, *Water quality, Planning, *Water use, Data collections, Urbanization, Water supply, Aquifer characteristics, Pollution abatement, Groundwater availability, Wells, Springs, Sampling, Water level fluctuations, *West Virginia, *Jefferson County.

Jefferson County is an area of 211 square miles in the Valley and Ridge Physiographic Province in the eastern panhandle of West Virginia. In 1970 the population was 21,280, up 14 percent from 1960; the population for the entire State of West Virginia for the same period decreased by 6.2 percent. Many of the new housing developments are not within municipalities; therefore, individual water supplies have been developed and septic-tank systems installed. Because much of the county is underlain by fractured and cavernous limestone aquifers that are susceptible to contamination, sewage-disposal and water-supply systems are designed for minimum contamination potential. This report contains information about the occurrence, quality, and quantity of ground water in the county, and the direction of its movement. Water levels were measured at 196 well sites, and samples were collected at 188 well and spring sites. All but a few measurements and samples were collected during September 16-27, 1974. Fifteen wells and three springs were sampled for bacteria and nitrate; several of these were resampled in March and May 1975. To trace the movement of ground water, dye was injected into two sinkholes, and possible discharge points were monitored using activated charcoal to trap the dye. However, no dye was recovered, even though discharge points were monitored for as long as 8 weeks after injection. Fracture traces and faults were mapped from aerial photographs, satellite imagery, and available geologic maps. (USGS)
W82-04986

COMPILATION OF HYDROLOGIC DATA FOR THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS, 1934-79.
Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04987

POSSIBILITY OF SUBSTANTIATING THE GROUNDWATER FLOW EQUATION ON THE BASIS OF THERMODYNAMICS OF IRREVERSIVBLE PROCESSES,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
N. A. Ogil'vi.
Water Resources, Vol 8, No 2, p 136-147, March-April, 1981. 1 Tab, 13 Ref. Translated from Vodnye Resursy, No 2, p 77-89, March-April, 1981.

Descriptors: *Geothermal studies, *Gravity flow, Thermodynamics, *Groundwater movement, Mathematical equations.

A refined groundwater flow equation is derived. The interrelated processes of transport of mass, energy and heat in rocks are very complex, and therefore certain simplifications are used in modeling. When using the phenomenological description of groundwater flow processes it was assumed that rocks not containing gas or oil are completely saturated with water, that the attached (pellicular and hygroscopic) water cannot form flows, and that the relative content of attached water is very small. Lorentz and Coriolis forces and flows of elastic energy related to seismic phenomena are ignored. Under these conditions the transport phenomena are governed by the mass fluxes and heat flux for the soil skeleton, pure water, and substances dissolved in water. For groundwater with a constant composition the flow equation is analogous to the empirical Darcy equation. The refined equation allows estimating the effect of the earth's gravity field and the effect of the geothermal field on groundwater flow. (Cassar-FRC)
W82-05032

ASSESSMENT OF A REGIONAL AQUIFER IN CENTRAL ILLINOIS,
Illinois State Water Survey Div., Champaign; and Illinois State Geological Survey Div., Champaign.
C. B. Burris, W. J. Morse, and T. G. Naymik.
Cooperative Groundwater Report 6, 1981. 79 p 28 Fig, 5 Tab, 32 Ref, 3 Append.

Descriptors: *Aquifers, Sand aquifers, Surface water, *Pumpage, Water table decline, Reservoirs, Groundwater storage, Water level, Water supply development, *Water table fluctuations, *Groundwater recharge, Hydrologic models, Selective withdrawal, Well screens, Water table wells, *Aquifer characteristics, *Central Illinois, Groundwater availability.

This study of a major Central Illinois aquifer was initiated to determine its adequacy for both present and future needs. The objectives were to identify the geologic and hydrologic characteristics of the aquifer, and to develop a numerical model that would predict the aquifer's response to future pumpage. The aquifer's northern and southern segments are considered two separate hydrologic entities and serve nine municipalities and one industry. From 1888 to the present, withdrawals have been increasing, particularly in the north near Taylorville. In the mid-50s, and in 1976, there were serious water shortages, but conservation, completion of Lake Taylorville and development of other supplies helped restore water levels. Though supplies have increased, total water withdrawn has not risen proportionately. The average daily pumpage outside Taylorville is about 1/3 the total water withdrawn from the aquifer's northern half. As of 1980, there has been no discernable water level decline due to pumpage outside of Taylorville. The model results indicate that the aquifer can meet present and future needs of the user communities, with the exception of Taylorville, which will be at critical levels by the year 2000. Updating and expanding the surface water treatment plant at Taylorville may be a solution. Data for the south part of the aquifer show no depletion due to pumpage. By 2000, pumpage should increase from the present 270,000 gpd to 278,000, and if recharge remains the same no declines are predicted. The most critical elements of water supply development in the aquifer's south half are well design and maintenance. Well performance monitoring can detect deterioration and allow remedial actions to be taken (Atkins-Omniplan)
W82-05052

STRUCTURE AND PERMEABILITY: GEOLOGIC CONTROLS ON INDUCED SEISMICITY AT NUREK RESERVOIR, TADJIKISTAN, USSR,
Columbia Univ., New York. Dept of Geological Sciences.
W. Leith, D. W. Simpson, and Z. W. Alvarez.
Geology, Vol 9, No 10, p 440-444, October, 1981. 6 Fig, 20 Ref.

Descriptors: *Seismology, *Geophysics, *Permeability, *Geologic formations, *Geohydrology, Boreholes, *Reservoirs, Interstitial water, Pore pressure, Anisotropy, Stress, Stress analysis, Geography, Borehole geophysics, Geologic faults, *Nurek Reservoir, *USSR.

Seismicity in the vicinity of the Nurek reservoir in the Soviet Union has been studied. The spatial distribution of seismicity was evaluated using borehole data and data from a high-resolution seismograph network installed at Nurek in 1975. Results indicate that seismicity is not homogeneously distributed. Two distinct areas were identified. In the aseismic area vertical fluid flow is blocked by a syncline that cups the base of the reservoir. Because the strata are essentially impermeable in this area, diffusion of water to depth is restricted, and effective stress ceases to be significant. In the seismic area, a plunging anticline that crops out beneath the reservoir allows water to flow to depth along bedding planes. This structure may serve as a means of predicting the local distribution of seismicity. (titus-FRC)
W82-05133

GROUND-WATER HYDROLOGY AROUND SALT DOMES IN THE EAST TEXAS BASIN: A PRACTICAL APPROACH TO THE CONTAMINANT TRANSPORT PROBLEM,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5B.
W82-05202

TEST-HOLE DATA FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05218

QUALITY OF GROUND WATER IN ROUTT COUNTY, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
K. J. Covay, and R. L. Tobin.
Geological Survey Water Resources Investigations Open-File Report 80-956, 1981. 38 p, 8 Fig, 1 Plate, 6 Tab, 17 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Geohydrology, Aquifer characteristics, Water yield, Wells, Springs, Water use, Water demand, Water analysis, Chemical analysis, Bacteria, Water quality standards, Maps, *Colorado, *Routt County, Yampa River basin.

Chemical and bacteriological data were collected to describe the quality of water from selected geologic units in Routt County, Colo. Calcium bicarbonate was the dominant water-chemistry type; magnesium, sodium, and sulfate frequently occurred as codominant ions. Specific conductance values ranged from 50 to 6,000 micromhos. Mean values of specific conductance, dissolved solids, and hardness from the sampled aquifers were generally greatest in waters from the older sedimentary rocks of the Lance Formation, Lewis Shale, Mesaverde Group, and Mancos Shale, and least in the ground waters from the alluvial deposits, Browns Park Formation, and the basement complex. Correlations of specific conductance with dissolved solids and specific conductance with hardness were found within specified concentration ranges. On the basis of water-quality analyses, water from the alluvial desposits, Browns Park Formation, and the basement complex generally is the most suitable for domestic uses. Chemical constituents in water from wells or springs exceeded State and Federal standards for public-water supplies or State criteria for agricultural uses were pH, arsenic, boron, chloride, iron, fluoride, manganese, nitrite plus nitrate, selenium, sulfate, or dissolved solids. Total-coliform bacteria were detected in water from 29 sites and fecal-coliform bacteria were detected in water from 6 of the 29 sites. (USGS)
W82-05227

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SAN SIMON WASH AREA, PAPAGO INDIAN RESERVATION, ARIZONA--1979,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05231

MAPS SHOWING GROUND-WATER CONDITIONS IN THE AGUA FRIA AREA, YAVAPAI AND MARICOPA COUNTIES, ARIZONA-1979,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05232

STREAM-AQUIFER INFLUENCE COEFFICIENTS AS TOOLS FOR SIMULATION AND MANAGEMENT,
Colorado State Univ., Fort Collins. Engineering Research Center.
T. Illangasekare, and H. J. Morel-Seytoux.
Water Resources Research, Vol 18, No 1, p 168-176, February, 1982. 6 Fig, 42 Ref.

Descriptors: *Aquifers, *Streamflow forecasting, *Water management, Streams, Pumping, Model studies, Water table, Drawdown, Wells, *Surface-groundwater relations.

The discrete kernel approach for an isolated aquifer is combined with the discrete kernel approach for an isolated stream to derive influence coefficients for a combined stream-aquifer system. The influence coefficients establish explicit relationships between the controllable decision variables and known initial conditions and the resulting states of the combined system. The aquifer and stream systems are coupled using a linear relation for the aquifer-stream interaction. A hypothetical system is used as an example. The effects of pumping from one or two wells in an aquifer adjoining a river are determined on the aquifer level, the direction of flow between river and aquifer, and the river level in three river reaches. (Cassar-FRC)
W82-05346

AN EVALUATION OF THE EFFECTIVENESS OF COMBINING ECONOMIC AND PHYSICAL GROUND-WATER MODELS,
Arizona Univ., Tucson.
T. Maddock, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236597, Price codes: A03 in paper copy, A01 in microfiche. Report, 1981. 30 p, 1 Fig, 3 Tab, 27 Ref. OWRT A-095-ARIZ(1), 14-34-0001-0103.

Descriptors: *Groundwater movement, *Geohydrology, *Hydrologic models, *Economic prediction, *Model studies, Groundwater runoff, Groundwater management, Base flow, Groundwater budget, Mathematical studies, Linear programing, Systems analysis, Economic aspects, Economic evaluation, Flow system, Costs, Evaluation.

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Techniques for combining or coupling regional groundwater flow models are evaluated. The two principal techniques described are linking and embedding. In the use of linking, the economic model and the hydrologic model are run at different stages: the economic model is run with known hydrologic factors (e.g., drawdown); the hydrologic model is then run with the output of the economic model as demands and the cycle are repeated. In the case of bedding, two approaches are used: difference equations and response functions. Using difference equations, the groundwater hydrogeology is molded by a set of linear equations derived from the partial differential equations of flow through porous media, and this set of equations is embedded directly into the eonomic model as a constraint set. Using response functions, a linear relationship between drawdown and stress (e.g., pumping) can be determined. It was found that the linking technique is preferrable for highly non-linear hydrologic systems, and that the response function approach is preferred for linear flow systems (and non-linear flow systems where good linear approximations exist or where a transformation can induce a linear system). (Zielinski-MAXIMA)
W82-05545

THE APPLICABILITY OF LARGE-DIAMETER, SHALLOW WELLS TO A COASTAL PLAIN HYDROGEOLOGIC ENVIRONMENT, GEORGIA,
Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.
For primary bibliographic entry see Field 3B.
W82-05548

NUMERICAL SIMULATION OF A THICK FRESHWATER LENS: PEARL HARBOR GROUNDWATER MODEL,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
C. K. Clark, L. S. Lau, and J. F. Mink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243296, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 139, December, 1981. 71 p, 14 Fig, 2 Tab, 31 Ref, 2 Append. OWRT A-090-HI(1), 14-34-0001-1113.

Descriptors: *Aquifer characteristics, *Computer models, *Groundwater movement, *Hydrologic models, Hydrogeology, Mathematical models, Numberical analysis, Darcy's law, *Hawaii, Simulation analysis, dispersion, Ghyben-Herzberg lens, Pearl Harbor aquifer.

The freshwater aquifer in the Pearl Harbor area on Oahu, Hawaii is the most important water resource of the island and constitutes a large proportion of its freshwater supply. The aquifer has a freshwater lens up to 304.8 m (1000 ft) thick floating on top of a saline water zone. Mechanisms of groundwater movement are extremely complex because the upper boundary is confined near the coast and phreatic inland, while the lower boundary is nowhere confined. In this study, regional groundwater movement due to various pumping schemes is mathematically simulated by a set of partial differential equations. These equations are then solved numerically with a finite difference approximation. The location of the freshwater and saltwater interface, which constitutes the lower boundary of the system model was estimated by Hubbert's formula. Consideration was also given to features concerning geohydrologic boundaries of the Pearl Harbor aquifer. It was concluded that a mathematical model can be used as a tool in the management of groundwater development in a thick Bhyben-Hergzerg aquifer. Improvement of system simulation may be achieved by adding a mass transport element to study hydrodynamic dispersion within a transition zone where fluid density changes gradually. (Author abstract)
W82-05621

TRACING INTERAQUIFER CONNECTIONS IN THE KEFAR URIYYA-AGUR REGION (ISRAEL), USING NATURAL URANIUM ISOTOPES,
TAHAL--Water Planning for Israel, Ltd., Tel Aviv (Israel).
J. Guttman, and J. Kronfeld.
Journal of Hydrology, Vol 55, No 1/4, p 145-150, 1982. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Uranium radioisotopes, *Aquifers, *Saline water, *Isotope studies, Radioisotopes, Senonian aquifer, Cenomanian aquifer, Groundwater movement, Kefar Uriyya-Agur, *Israel, Tracers.

The natural uranium isotopic technique was used to detect a hydrologic connection between two strata in the Kefar Uriyya-Agur region west of Jerusalem, Israel. The Senonian aquifer, which overlies the Cenomanian aquifer, contains low-grade uranium phosphates. The natural U content of water samples from the aquifers were: Senonian, 60 micrograms per liter; Cenomanian under Senonian, 1-50 micrograms per liter; and Cenomanian not overlain by Senonian, 1-2 micrograms per liter. A relationship between the thickness of the overlying Senonian and the excess U234 activity was also demonstrated. This evidence shows that the Senonian aquifer is connected to, and contributes to, the water of the Cenomanian aquifer. This may account for the transfer of salinity, indigenous in the very poor quality Senonian aquifer, to the important Cenomanian aquifer. (Cassar-FRC)
W82-05644

EVIDENCE FOR A SHALLOW HIGHLY-PERMEABLE ZONE IN THE CHALK OF HAMPSHIRE, U.K.,
Southern Water Authority (England).
H. G. Headworth, T. Keating, and M. J. Packman.
Journal of Hydrology, Vol 55, No 1/4, p 93-112, 1982. 12 Fig, 3 Tab, 24 Ref.

Descriptors: *Aquifers, *Geologic fissures, *Permeability, Streamflow, Groundwater, *Chalk aquifer, Candover River, Transmissivity, Storativity, Water level fluctuations, Pumping tests, Carbonate aquifers, Flow augmentation, Rivers, United Kingdom, *England(Hampshire).

The Chalk Aquifer in England is most productive 20-50 m below the water table. Yield from this very fine grained limestone formation decreases with depth. Most of the active storage and permeability is confined to fissures making up 1-2% of the total volume. However, river abstraction studies in the Candover catchment in Hampshire revealed the existence of an unusually well-fissured 6 m thick zone. In the Candover catchment annual groundwater fluctuations are only 3-5 m (one-third of those in other areas), the water table is unusually flat (1 in 500 gradient), and storativity is 5-7% (compared with 1-3% elsewhere). Studies of streamflows during and after long-term pumping tests suggested that the fissured zone acted as an important conduit to streamflows. Streamflows entering the river in its upper and lower reaches are similar, suggesting that the river is fed by different levels of the aquifer having similar response times (transmissivity/storativity ratios). The upper and lower aquifer zones appear to be hydraulically connected and controlled by the same head. Extensive pumping from the aquifer into the river produced a concentration of depression which decreased streamflows for several months after pumping had stopped. (Cassar-FRC)
W82-05645

AN ENRICHED FINITE ELEMENT FOR SIMULATION OF GROUNDWATER FLOW TO A WELL OR DRAIN,
Wright State Univ., Dayton, OH. Dept. of Geology.
T. M. Tharp.
Journal of Hydrology, Vol 55, No 1/4, p 237-245, 1982. 5 Fig, 11 Ref.

Descriptors: *Finite element method, *Wells, *Drains, Fluid flow, Simulation analysis, Groundwater movement, Porous media, Model studies.

A quadrilateral finite element was developed to simulate a well or drain in two-dimensional fluid flow through porous media. The enriched four-node element models the logarithmic head distribution about a well located at its center. The enriched element is compatible at its broundaries with unenriched elements and can represent head boundary conditions at the well. The element is most accurate with a large ratio of element diameter/well diameter and for coarse meshes, as are used in regional groundwater studies. Accuracy is less for dense arrays with very large ratios of well diameter/element diameter. (Cassar-FRC)
W82-05652

THE LIKELIHOOD OF ACTIVE GROUNDWATER RECHARGE IN THE BOTSWANA KALAHARI,
Institute of Geological Sciences, Wallingford (England). (United Kingdom).
For primary bibliographic entry see Field 4B.
W82-05657

DETERMINATION OF AQUIFER PARAMETERS USING REGRESSION ANALYSIS,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 18, No 2, p 325-330, April, 1982. 2 Fig, 6 Tab, 13 Ref.

Descriptors: *Aquifer characteristics, *Regression analysis, *Transmissivity, Graphical analysis, Storativity, Pumping tets, Drawdown, Wells, Artesian aquifers, Confined aquifers, Leaky aquifers, Water table aquifers.

A method for determining aquifer transmissivity and storativity, which avoids the errors inherent in graphical analysis, is described. Regression analysis of the nonsteady time drawdown field data is performed by hand held calculator. Examples are given for four situations: a well penetrating a confined aquifer, a production well fully penetrating a nonleaky artesian aquifer, a leaky artesian aquifer, and a water table aquifer. Comparison of results showed that this method is a viable alternative to Theis or Jacob graphical solutions for nonleaky artesian aquifers. However, it did not perform well for leaky artesian aquifers at small values of time or for water table aquifers. (Cassar-FRC)
W82-05734

WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES AT FORT MACKAY, ALBERTA,
Northern Illinois Univ., DeKalb. Dept. of Geology.
For primary bibliographic entry see Field 4B.
W82-05780

THE HYDROGEOLOGICAL BASIS FOR A WATER SUPPLY TO KABWE, ZAMBIA,
Aspinwall Hydrotechnical Services Ltd. (England), (United Kingdom).
For primary bibliographic entry see Field 4B.
W82-05804

CAPE COD AQUIFER, CAPE COD, MASSACHUSETTS,
Geological Survey, Providence, RI.
B. J. Ryan.
Journal of the New England Water Works Association, Vol 96, No 1, p 25-54, 1982. 8 Fig, 5 Tab, 49 Ref.

Descriptors: *Aquifers, *Water supply, *Geohydrology, Cape Cod, *Massachusetts, Groundwater, Water quality, Hydrologic properties, Recharge, Groundwater recharge, Groundwater pollution, Saline water intrusion, Wells, Municipal water, Saline-freshwater interface, Water pollution sources, Wastewater disposal, Salt, Deicers, Recreation.

Existing information on the Cape Cod Aquifer, Massachusetts, was compiled. As of 1978 over 100 municipal wells and 15,000 private wells were withdrawing water from the aquifer, which is composed of unconsolidated deposits of sand, gravel, silt, and clay. Bedrock ranges from 80 to 900 ft below sea level. The aquifer is unconfined except

along the north shore between Bourne and Brewster, along the south shore, and at Chatham and Orleans. There is a saline-freshwater mixing zone where chloride concentrations range from 25 to 18,000 mg per liter. Natural recharge (average 18 inches per year) is from precipitation infiltrating into the sandy soils. Discharge is from wells, evapotranspiration, evaporation from the water table and seepage to rivers, marshes, and ocean. Water quality is generally good low in dissolved solids, soft, and mildly acidic. Dominant ions are Na and Cl. In some locations water is naturally high in Fe, Mn, hydrogen sulfide, and salt. Contamination has resulted from land-deposited wastewaters, solid waste disposal dumps, deicing salt storage areas, spills of chemicals and fuels, urban runoff, and saline-water intrusion. In 1978 6.4 billion gallons were pumped by public water systems for supplying 80% of the population, which in 1975 ranged from 127,000 in winter to 382,000 in summer. Alternative drinking water sources are desalination of saline water, transport from the mainland, and rainwater cisterns. (Cassar-FRC)
W82-05807

MAP SHOWING GROUND-WATER CONDITIONS IN THE SACRAMENTO VALLEY AREA, MOHAVE COUNTY, ARIZONA--1979,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05827

HYDROGEOLOGIC RECONNAISSANCE OF THE REPUBLICAN RIVER BASIN IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05828

CHLORIDE AND TOTAL HARDNESS CONCENTRATIONS OF WATER FROM THE UPPER PART OF THE FLORIDAN AQUIFER IN ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05829

HYDROGEOLOGIC SECTIONS THROUGH LEE COUNTY AND ADJACENT AREAS OF HENDRY AND COLLIER COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05830

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson, and P. R. Johnson.
Geological Survey Open-File Report 81-905 (WRI), 1981. 32 p, 16 Fig, 10 Ref.

Descriptors: *Groundwater, *Glacial aquifers, *Aquifer characteristics, *Geohydrology, Wells, Natural recharge, Water yield, Well logs, Surface-groundwater relations, Glacial drift, Glacial sediments, Groundwater potential, *Alaska, Kenai Peninsula Borough, Ninilchik, Anchor Point.

Most residential and industrial development of the Lower Kenai Peninsula, Alaska, is along the coast of Cook Inlet. Most of the information about subsurface conditions is obtained from wells along the coast. Ground water is recharged by local precipitation, and slow drainage of ground water to the streams maintains streamflow during winters and periods of no precipitation. Sedimentary bedrock of the Tertiary Kenai Group is the principal source of water to wells, but subsurface data are too sparse to differentiate individual aquifers within the bedrock. Most bedrock wells are completed in poorly consolidated sandstone. Glacial till overlies bedrock in much of the study area, but few wells obtain water from the poorly permeable till. Glacial outwash and abandoned-channel deposits in major drainageways of alluvial plains provide water to wells but are little utilized and have not been explored by drilling. Intermorainal valleys and areas of low relief are poorly drained, and bog deposits overlie surficial materials in parts of the area. Bog deposits contain highly colored, iron-rich water that is undesirable to most consumers. Lacustrine clays overlie and are interbedded with fluvial materials and contain little extractable water. Streams have incised older glacial sediments and deposited alluvium along the present flood plains. Where the alluvium is thick enough, it has good potential for providing ground water to high-capacity wells. However, production of ground water from alluvium or other deposits hydraulically connected to streams will reduce streamflow. Surficial deposits with the best potential for developing significant ground-water supplies in the study area are the deltaic complex near the mouth of Kasilof River, the alluvium of Crooked Creek, and abandoned-channel deposits in the alluvial plain near Ninilchik and in an ancestral drainageway of Tustumena Glacier south of Crooked Creek. (USGS)
W82-05837

COMPUTER SIMULATION OF THE STEADY-STATE FLOW SYSTEM OF THE TERTIARY LIMESTONE (FLORIDAN) AQUIFER SYSTEM IN EAST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. H. Tibbals.
Geological Survey Open-File Report 81-681 (WRI), 1981. 31 p, 10 Fig, 4 Tab, 20 Ref.

Descriptors: *Groundwater, *Simulation analysis, *Confined aquifers, *Groundwater movement, Limestone, Recharge, Springs, Transmissivity, Computer models, *Florida, East-central Florida, Floridan aquifer.

The predevelopment steady-state ground-water flow system for 13,700 square miles of the Tertiary limestone aquifer system (known as the Florida aquifer in Florida) in east-central Florida is simulated by means of a digital computer model. The model results indicate that about 1,900 cubic feet per second recharges the aquifer as downward leakage from the surficial aquifer. The average recharge rate where recharge actually occurs (approximately 6,550 square miles) is about 4 inches per year. The maximum recharge rate is about 14 inches per year. An additional 21 cubic feet per second is recharged to the modeled area of the aquifer by means of lateral boundary inflow along the northeast boundary. The Floridan aquifer system, as simulated, discharges 1,300 cubic feet per second as springflow, 540 cubic feet per second as diffuse upward leakage to the surficial aquifer in an area of approximately 7,150 square miles and 81 cubic feet per second as lateral boundary outflow to the southwest and to the east. The average transmissivity of the upper unit of the aquifer, as simulated, is about 120,000 square feet per day while that for the lower unit is about 60,000 square feet per day. (USGS)
W82-05844

HYDROLOGY AND THE EFFECTS OF INDUSTRIAL PUMPING IN THE NIKISKI AREA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson.
Geological Survey Open-File Report 81-685 (WRI), 1981. 22 p, 11 Fig, 5 Ref.

Descriptors: *Groundwater, *Water use, *Industrial water, *Pumping, *Drawdown, Recharge, Aquifer systems, Water level fluctuations, Lakes, Water quality, Saline water intrusion, Groundwater potential, *Alaska, Nikiski.

Industries in the Nikiski area pumped about 4.2 million gallons of water per day from three aquifers in 1979. The upper confined aquifer, from which most of the water is pumped, is recharged by leakage from the overlying unconfined aquifer. The unconfined aquifer is hydraulically connected to lakes and streams. The lower confined aquifer, the deepest of the three aquifers, is hydraulically poorly connected to the other two aquifers. Drawdown caused by pumping appears to have stablized in all three aquifers, but water levels continue to fluctuate in response to annual changes in precipitation. In the lower two aquifers, the potentiometric surfaces near some production wells are below sea level; however, no salt water had intruded the aquifers as far as the pumped wells. If additional water supplies are needed, another potential site for ground-water development is the Beaver Creek basin, 7-10 miles east of the industrial area. (USGS)
W82-05846

2G. Water In Soils

EFFECTS OF USE PATTERN, COVER, SOIL DRAINAGE CLASS, AND OVERWINTER CHANGES ON RAIN INFILTRATION ON CAMPSITES,
Ohio Agricultural Research and Development Center, Wooster.
J. P. Vimmerstedt, F. G. Scoles, J. H. Brown, and M. C. Schmittgen.
Journal of Environmental Quality, Vol 11, No 1, p 25-28, January-March, 1982. 5 Tab, 22 Ref.

Descriptors: *Rainfall, *Infiltration, Rainfall infiltration, Soil types, Infiltration rate, Sedimentation, Erosion, Rainfall-runoff relationships, Sediment yield, Simulation, Storms, Land use, Recreation, *Campsites, Vegetation effects, *Seasonal variation, *Drainage patterns.

Objectives of this study were to determine the effect of soil drainage class, vegetative cover, and intensity of use within a campsite on rainfall infiltration, sediment yield, and soil bulk density. The changes occurring in various parameters over the winter season were also determined. Campsite conditions at 15 Ohio Public campgrounds were used as the study sites. Infiltration and sediment yield were measured during 60 minute applications of 11 cm of simulated rain on campsite use zones, using a spray infiltrometer. Initial percentages of infiltration were 82 and 89 in fall and spring with sod cover, and 68 and 79 in fall and spring with hardwood cover. Initial infiltration also varied with use zone and season: heavy use showed 52% in the fall, 65% in the spring; moderate use showed 79% in the fall, and 87% in the spring; and light use showed 95% in fall and 99% in spring. Fall infiltration during the last 10 min of simulated streams on poorly drained soils was 4% with sod cover vs 12% with hardwood cover. On well drained soils, the cover effect was reversed. Final infiltration rate and total infiltration changed but little from one use zone to another on poorly drained campsites, but on well- or excessively drained soils there was a marked and progressive reduction in infiltration from light to moderate and heavy use zones. Sediment concentration in runoff and soil bulk density increased with use intensity. (Baker-FRC)
W82-04858

THE EFFECT OF RAINDROP IMPACT ON THE DYNAMICS OF SOIL SURFACE CRUSTING AND WATER MOVEMENT IN THE PROFILE,
Israel Soil Conservation and Drainage Div., Emek Hefer. Soil Erosion Research Station.
J. Morin, Y. Benyamini, and A. Michaeli.
Journal of Hydrology, Vol 52, No 3/4, p 321-335, July, 1981. 10 Fig, 3 Tab, 13 Ref.

Descriptors: *Rainfall infiltration, *Infiltration rate, *Surface sealing, Soil profiles, Loess, Sand, Permeability coefficient, Clays, Mathematical studies, *Soil types, Mathematical models.

The infiltration of rainfall into bare soil was studied in field and laboratory experiments on two types of soil in Israel: hamra, a soil composed of 85 percent sand and 13 percent clay, and loess. The formation of a crust with an hydraulic conductivity several orders of magnitude lower than that of the soil profile was the primary process governing

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the infiltration rate. The decrease in hydraulic conductivity is attributed to the organization of a very thin layer on the soil surface. The sealing efficiency of this crust is achieved by suction forces which arrange soil particles, probably clay, into a continuous, dense layer. Conditions of unsaturated flow in the soil profile below the crust result from the decrease in flux through the crust. An analytical model was used to analyze the dynamics of the changes in the different soil parameters from the beginning of the rainfall until the soil crust was completely formed. (Carroll-FRC)
W82-04868

EFFECTS OF SULFURIC ACID RAIN ON MAJOR CATION AND SULFATE CONCENTRATIONS OF WATER PERCOLATING THROUGH TWO MODEL HARDWOOD FORESTS,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5C.
W82-04872

USE OF SPECTRAL DATA TO ESTIMATE THE RELATIONSHIP BETWEEN SOIL MOISTURE TENSIONS AND THEIR CORRESPONDING REFLECTANCES,
Purdue Univ. Lafayette, IN. Water Resources Research Center.
J. B. Peterson, and M. F. Baumgardner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224528, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 143, 1981, 36 p, 22 Fig, 19 Ref, 4 Append. OWRT A-061-IND(2).

Descriptors: *Soil water, *Soil moisture, *Remote sensing, *Reflectance, Moisture tension, Optical properties, Soil properties, Soil types.

Fifty-seven soils covering a wide range were studied for the relationship between their loss in reflectance when wet versus their oven dry reflectance. Regression analysis revealed R2 values of .196 and .963 for the water absorption bands and of .845 for one of the visible bands, 0.52 to 0.58 um. Twelve of the soils were brought to equilibrium with 1/3 and 1/10 bar moisture levels and compared with oven dry. This study revealed that soils of high cation exchange capacity generally exhibited very low reflectance when moist whereas a stairstepped relationship existed for the sandier soils. To further appraise the effect of different moisture levels to reflectance, 11 soils were equilibrated at 10 and 15 bar moisture tension and the spectral data compared with those for oven dry, 1/3 and 1/10 bar. Reflectance data for oven dry, 15, 10, 1/3 and 1/10 on these samples revealed three general patterns of spectral response for these soils. The fine textured soils showed low reflectance for the wetter levels with little differentiation; the sandy soils showed much higher, brighter responses for the drier samples than for the wetter moisture levels. A more even gradient of reflectance existed for the silt loams. However, there were enough exceptions to these groupings to indicate the presence of other causative factors than color and/or texture not yet evaluated.
W82-04963

ESTIMATION OF MOISTURE EXCHANGE OF GROUNDWATER WITH ROCKS OF THE ZONE OF AERATION IN THE WINTER AND SPRING,
A. A. Konoplyantsev, V. K. Sedova, and I. V. Obukhova.
Water Resources, Vol 8, No 2, p 148-154, March-April, 1981. 5 Fig, 2 Tab, 9 Ref. Translated from Vodyne Resursy, No 2, p 90-97, March-April, 1981.

Descriptors: *Groundwater level, *Aeration zone, *Freezing, Thawing, Soil water, Infiltration, Frozen ground, Precipitation, Seasonal variation, Water storage.

Observations of the moisture content and temperature of the rocks of the zone of aeration, the level and temperature of the groundwater, and meteorological factors were studied under natural conditions from 1968 to 1979 in an experimental area near Moscow. The confined aquifer occurred in unequigranular fluvioglacial sands of permeability 0.5 to 30 m per day. Groundwater level was 3.5-4.5 m. In winter and spring moisture was discharged from the groundwater level to the zone of aeration. The amount of moisture discharged varied from 2.5 to 55.4 mm. The quantity of moisture drawn from the groundwater level during freezing depended on the moisture storage in the rocks of the zone of aeration at the start of freezing. The smaller the zone of aeration, the larger were the quantities of moisture drawn from the groundwater level. When the moisture content of the rocks in the zone of aeration was less than 12%, the rock moisture content was directly related to the rate of freezing of the ground and little or no moisture was withdrawn from the groundwater level in winter. In spring the groundwater level rose, starting in March or early April. This rise was caused by the inflow of moisture stored in the zone of aeration, not from infiltration of precipitation. Only after complete thawing of rocks in the zone of aeration did infiltration of precipitation begin. Thawing of rocks began at lower depths and proceeded toward the surface. As thawing progressed, the moisture content of the rocks increased, and the groundwater level began to rise long before thawing was completed. (Cassar-FRC)
W82-05043

AN APPROXIMATE METHOD OF ESTIMATING SOIL WATER DIFFUSIVITY FOR DIFFERENT SOIL BULK DENSITIES,
Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil).
P. L. Libardi, K. Reichardt, C. Jose, and M. Bazza.
Water Resources Research, Vol 18, No 1, p 177-181, February, 1982. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Diffusivity, *Soil density, *Infiltration, Density, *Soil water, Bulk density, *Estimating equation.

Reichardt and Libardi's method (1973) for determining the effect of soil bulk density on soil water diffusivity and infiltration was extended to 13 soils varying in density from 0.900 to 1.7 g per cu cm. Dry soils were placed in 50 cm long plastic cylinders and tapped to produce several bulk density values for each soil. A generalized equation was presented to express the soil water diffusivity for any soil as a function of the soil water content and soil bulk density, knowing the rate at which the wetting from advances for one value of bulk density. (Cassar-FRC)
W82-05073

OPTIMIZATION PRINCIPLE FOR AIR AND WATER MOVEMENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J-Y. Parlange, R. D. Braddock, R. W. Simpson, and D. E. Hill.
Soil Science, Vol 133, No 1, p 4-9, January, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Earth-water interfaces, *Mathematical equations, Optimization, *Soil water, Leaching, Sediment transport, Solute transport, Air-water interfaces, Groundwater movement, Subsurface water.

The aim of this paper is to describe the structure of the water profile and accurately predict water intake using an optimization principle. The principle can be used first of all to accurately predict water intake into a soil when air movement is not negligible. The principle is also useful for solving the transport equation numerically, avoiding numerous iterations. Finally, analytical approximations can be greatly improved when the principle is taken into account. These three applications of the optimization principle are illustrated by comparisons with an exact solution of the water movement equation obtained using Brutsaert's technique. (Baker-FRC)
W82-05172

SIMPLIFYING NEUTRON MOISTURE METER CALIBRATION,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W82-05173

REDUCED RUNOFF AND NONPOINT SOURCE POLLUTION THROUGH INCREASED INFILTRATION,
Pennsylvania State Univ., University Park.
A. R. Jarrett, and J. R. Hoover.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224759, Price codes: A07 in paper copy, A01 in microfiche. Report, November 1981. 114 p, 34 Fig, 9 Tab, 58 Ref. OWRT A-055-PA(1), 14-34-0001-1140.

Descriptors: *Surface runoff, *Nonpoint pollution sources, *Rainfall infiltration, *Infiltration capacity, *Soil water, Runoff, Rainfall-runoff relationships, Infiltration, Infiltration rate, Free water, Air entrainment, Sand, Intestitial water, Soil porosity, Pervious soils, Soil tests, Soil saturation, Agricultural runoff, Agricultural hydrology, Technology.

Three studies were carried out to assess the effects of increased soil infiltration on the reduction of runoff and nonpoint source pollution. The first study examined surface venting of entrapped soil air for increasing infiltration in sand. Simulated rainfall was applied to a large 75 cm thick sand sample having 13 different surface variations or venting mechanisms, with soil-air pressure measured at seven piezometer locations and runoff recorded. Air entrapment reduced water infiltration, while the installation of air wells, holes, and vertical mulch columns significantly increased infiltration rates. The second study estimated the kinetic energy of escaped soil air and its effect on the detachment of soil particles in dry and saturated soil conditions. Also examined was the combined effects of overland flow, escaped soil air, and its transport by overland flow. In the third study, a preliminary field study showed that shallow drainage systems reduced air entrapment, peak runoff, total runoff, sediment concentration and sediment load on tilled land. Where air entrapment is a problem, farmers can install subsurface drain tiles to enhance infiltration and soil water storage capacity. (Zielinski-MAXIMA)
W82-05300

CONFIGURATION OF ICE IN FROZEN MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W82-05615

ON DETERMINING VOLUMETRIC SOIL MOISTURE VARIATIONS IN PEAT BY THE GRAVIMETRIC METHOD,
Toronto Univ. (Ontario). Dept. of Geography.
D. S. Munro.
Soil Science, Vol 133, No 2, p 103-110, February, 1982. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Soil water, *Porosity, *Saturated soils, Peat, Beverly Swamp, Hamilton, Ontario, Volumetric analysis, Organic matter, Soil porosity, Soil density, Density.

The most suitable method for determining soil moisture during a three-summer weekly sampling program of periodically flooded peat was the volume ration method. This method determined the ratio of water in the sample to total sample volume. It was sensitive only to error in sampling the water fraction of the soil. The effect of the error was small in porosity estimates made from unsaturated peat samples and would probably be even less important in estimating the soil moisture fraction of unsaturated soil. Volume ratio estimates of soil porosity in Beverly Swamp, near Hamilton, Ontario, were: samples above the water table, 0.821 in the surface layer, decreasing to 0.642 at 50-60 cm depth; and samples below the water table, 0.863 in the surface layer, decreasing to 0.750 at 60-70 cm depth. The more common method of measuring soil mositure by multiplying in situ bulk density by sample weight ratio of water to solid

produced unreasonable results, 0.82-0.86 throughout the soil profile. Standard errors in the volume method (0.003-0.039) were less than standard errors in the weight method (0.03-0.05). (Cassar-FRC)
W82-05616

SOIL WATER AVAILABILITY,
Science and Education Administration, Temple, TX. Grassland, Soil and Water Research.
J. T. Ritchie.
Plant and Soil, Vol 58, No 1-3, p 327-338, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Available water, *Soil water, *Evapotranspiration, *Root zone, *Soil-water-plant relationships, *Model studies, Transpiration, Soil water potential, Mathematical studies, Drainage, Subsurface drainage, Evaporation, Hydrologic budget.

The upper and lower limits of soil water availability are often difficult to define because of water flow into and out of the root zone and because of incomplete extraction by sparse roots at the lower boundaries of the root zone. For accurate soil water balance modelling, it is important to obtain accurate measurements of these upper and lower limits in the field. A simple field-measured drainage function is described for determining the time when water is available above the upper limit while soils are draining. The extractable water may then be estimated using only soil water content measurements taken preferably by a neutron meter. Once the range of extractable soil water is established, some general relationships to reduce transpiration can be established. Above 70% of the range of extractable soil water, transpiration is affected little by soil water deficit. In dry regions where evapotranspiration is the critical factor in soil water balance modelling, accurate calculations of transpiration are vital. (Geiger-FRC)
W82-05623

A FIELD METHOD FOR MEASURING SHORT-CIRCUITING IN CLAY SOILS,
Soil Survey Inst., Wageningen (Netherlands). Dept. of Soil Physics.
J. Bouma, L. W. Dekker, and C. J. Muilwijk.
Journal of Hydrology, Vol 52, No 3/4, p 347-354, July, 1981. 4 Fig, 7 Ref.

Descriptors: *Clays, *Soil moisture retentiion, Soil physics, *Soil types, Vertical flow, Flow characteristics, *Soil water, Flow measurement, *Unsaturated flow, Field tests.

Vertical flow of free water along the walls of macropores in unsaturated soils, a process called short-circuiting, has been observed in clay soils in the field during natural rainfall and during sprinkling irrigation. A method for measurement of short-circuiting in the field is described. A cylinder with a diameter and height of 20 centimeters is filled with undisturbed surface soil and is placed on a perforated disk in a funnel. The funnel is supported to allow periodic measurement of the volume of outflow from the soil. This assembly, together with a similar assembly with no surface soil, is placed along the track of a spray gun used for sprinkling irrigation. At least four samples can be measured during one run, while the assembly without soil measures the total water applied to the soil. The measured short-circuiting in a heavy clay soil, in a light clay soil with two different types of structure in and adjacent to potato ridges, and in a heavy clay soil with two types of surface microrelief is reported. Results of these measurements show that the tortuosity of the macropores and their size distribution significantly affect the degree and duration of short-circuiting. Increasing the microrelief of heavy clay soil was found to significantly retard sort-circuiting. Reduction of short-circuiting is advisable, since this phenomenon results in the rapid movement of irrigation water to the subsoil without benefit to the roots of plants and without wetting and leaching the soil between macropores. In addition, short-circuiting may result in rapid movement of surface-applied fertilizers to deeper layers. (Carroll-FRC)
W82-05626

SUBSURFACE FLOW VELOCITIES THROUGH SELECTED FOREST SOILS, SOUTH ISLAND, NEW ZEALAND,
Forest Research Inst. Christchurch (New Zealand).
For primary bibliographic entry see Field 4C.
W82-05712

THE RELATIONSHIP BETWEEN 018 AND DEUTERIUM IN WATER IN SAND COLUMNS UNDERGOING EVAPORATION,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison.
Journal of Hydrology, Vol 55, No 1/4, p 163-169, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Isotope studies, *Evaporation, *Deuterium, *Oxygen isotopes, Recharge, Groundwater recharge, Arid lands, Water vapor, Stable isotopes, Groundwater.

Slopes produced by plotting deuterium against 018 (% relative to standard mean ocean water) were as follows: soil water in unsaturated sand subjected to evaporation in columns for 3.8 to 15.8 days, 2.4 to 4.6; water evaporating from an open pan, 5. The lower slope values corresponded with the longer evaporation times in the columns. This effect is produced by the increasing thickness of sand through which the water must travel. In the beginning of the evaporation period water movement to the surface is predominantly by liquid flow, and the slopes are similar to the saturated case. As evaporation proceeds and the water must travel further to reach the surface, the vapor phase movement predominates and the 018-D relationship changes. The suggests that in very arid areas groundwaters replenished by local recharge are characterized by lower 018-D slopes. (Cassar-FRC)
W82-05759

LEACHING FRACTIONS AND SALT STATUS OF TWO IRRIGATED GYPSUM-RICH SOILS IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
C. Chang, S. Dubetz, T. G. Sommerfeldt, and D. C. MacKay.
Canadian Journal of Soil Science, Vol 62, No 1, p 97-103, February, 1982. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Soil chemistry, *Irrigation, Leaching, Soil water, Salinity, Salts, Calcium, Mathematical studies, *Alberta, *Canada.

The objectives of this study were to determine the changes in soil salinity at two field sites and to develop a new method for calculating the leaching fractions in typical irrigated soils near Tilley, Alberta, after more than 60 years of flood irrigation. This information is useful in assessing the adequacy of existing irrigation practices. Two sites with long term salinity status records were selected. The salt content in the surface 60 cm of soil was initially lower than that below, and remained fairly low throughout the years of irrigation. The rate of leaching of salts below 60 cm was very fast in the beginningd decreased to 1.6% of the initial rate at Tilley 1. The salt content in the soil apparently reached a pseudosteady state after 43 yr of irrigation. About 7 years were required for one pore volume of water to leach through the 180 cm profile. After 7 years of irrigation about half of the leachable salt was leached out of the soil profile. Since the average calcium content of the soil profile decreased linearly with time, the crop uptake of calcium was small compared to the total annual losses of calcium. The main loss of calcium was attributed to leaching. Drainage volume was obtained from the use of calcium concentration in the saturated extracts of soil rich in gypsum and the net leaching loss of soluble calcium. The results of this study indicate that the new method developed by determining drainage volume is reliable. The water balance method is simple, but it requires accurate data on the annual rate of irrigation and precipitation, and on crop consumptive use. (Baker-FRC)
W82-05762

2H. Lakes

ABIOGENIC ELIMINATION OF NUTRIENTS IN A NEWLY BUILT RESERVOIR (TWISTETALSPERRE, NORDHESSEN) (ABIOGENE NAHRSTOFFELIMINIERUNG IN EINER NEUENTSTANDENEN TALSPERRE (TWISTETALSPHERRE, NORDHESSEN),
Kassel Univ. (Germany, F. R.). Zoologisches Inst.
K. Schocke.
Archiv fur Hydrobiologie, Vol 80, No 4, p 483-508, August, 1980. 10 Fig, 6 Tab, 49 Ref.

Descriptors: *Reservoirs, *Nutrients, *Adsorption, *Phytoplankton, Reservoir stages, Phosphates, Nitrates, Ammonium, Silica, Diatoms, Algal growth, Bottom sediments, Clay.

The development of phytoplankton and some chemical aspects of the water composition were studied over a two-year period following the filling of a new reservoir. The bottom of the reservoir is lined with clay material of high ion exchange capacity. The total adsorptive capacity of this material, including the clays with chemically bound aluminum and iron, decreased the nutrient content of the reservoir water by adsorption of cations and anions. Dissolved silica in particular was adsorbed. As a result, silica became a limiting factor for diatom growth during the first year of observation. Samples of the bottom material were collected from various sites in the reservoir and their adsorption capacity tested by incubating with seawater samples for 24 hr in the laboratory. These studies showed that 28 mg Si/sq m were fixed in 24 hr. Some of the orthophosphate and ammonia in the water was also adsorbed in laboratory experiments; in field studies, no clear distinction between abiogenic and biogenic factors could be made with respect to phosphate and ammonia removal. During the first year of the investigation sufficient phosphate and ammonia were still present to permit phytoplankton growth. Biological removal of phosphate predominated. Nitrates were not adsorbed. Calcium. Magnesium and chlorides also decreased due to the effects of the reservoir bottom: nevertheless this decrease was insignificant. (Carroll-FRC)
W82-04768

ALGAL BIOASSAY OF THE PORTAGE LAKES, SUMMIT COUNTY, OHIO,
Akron Univ., OH. Dept. of Biology.
J. H. Olive, and G. Higgins.
Environmental Pollution, Series A, Vol 26, No 1, p 59-67, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Algal, *Bioassay, *Lakes, Nutrients, Phosphates, Nitrates, Lentic environment, Lotic environment, *Ohio, Summit Ccounty, *Portage Lakes.

The Portage Lakes are a series of natural lakes and man-made reservoirs in the upper Tuscarawas River of northeastern Ohio. Algal bioassays were used to determine the effects of phosphate and nitrate enrichment on the algal growth potential in the lakes and to predict the effects of diverting algal nutrients from one part of the lake ystem to another area within the system. The temporal patterns of water fertility appeared to be different for standing waters than for those with more of the characteristics of running waters, probably as a result of differences in nutrient availability. In lentic environments, algal growth rates ranged from about 0.6 doublings per day in early summer to less than 0.2 doublings per day in late summer. Algal growth rates in more lotic environments increased from between 0.2 and 0.3 doublings per day in June to between 0.3 and 0.5 doublings in July, followed by a decline to less than 0.3 doublings per day in August. Nutrient enrichments with PO4-P and NO3-N suggested that phosphorus was usually the major limiting nutrient in both groups of lakes, although NO3-N additions sometimes stimulated algal growth in the lotic environments. (Carroll-FRC)
W82-04813

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TOWARDS DIGITAL TECHNOLOGY IN THE MEASUREMENT AND CONTROL OF WATER LEVELS,
Churchill Controls Ltd., Reading (England).
For primary bibliographic entry see Field 7B.
W82-04847

PRIMARY PRODUCTION IN SALINE LAKES,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer.
Hydrobiologia, Vol 81, p 47-57, 1981. 3 Fig, 2 Tab, 28 Ref.

Descriptors: *Saline lakes, *Primary productivity , Lakes, *Phytoplankton, Plankton, Reviews, Variability.

The paper compares the results of several studies made on the variability of primary production in saline waters and related parameters. Phytoplankton primary production is discussed in terms of hourly volumetric rates, daily volumetric rates, areal rates, annual rates of primary production, chlorophyll a and a photosynthetic capacity, and efficiency of integral photosynthesis. Also presented are factors which influence algal biomass and rates of primary production. Photosynthetic bacterial primary production, macrophyte primary production, and Aufwuchs primary production are also reviewed. While extensive work has been done in establishing upper limits of photosynthesis in saline lakes, major problems still exist regarding the usefulness of light and dark bottles for accurately measuring the rates in highly productive lakes. Also, the factors which limit production in saline lakes should be examined more closely along with further studies into aquatic macrophytes and Aufwuchs production. (Baker-FRC)
W82-04926

A COMPARISON OF VASCULAR VEGETATION AND PROTOZOAN COMMUNITIES IN SOME FRESHWATER WETLAND OF NORTHERN LOWER MICHIGAN,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
M. S. Henebry, J. Cairns, C. R. Schwintzer, and W. H. Yongue.
Hydrobiologia, Vol 83, No 3, p 353-375, 1981. 2 Fig, 13 Tab, 80 Ref.

Descriptors: *Wetlands, *Protozoa, Marshes, Bogs, Fens, Swamps, Eutrophication, Chemical properties, Aquatic animals, *Ecosystems, Lakes, Vegetation, *Michigan.

This study was designed to examine vegetation, water levels, water chemistry and Protozoa in the major wetland types to determine similarities and differences among wetland types and extent of covariation between vegetation, Protozoa, and water characteristics. The wetlands included in the study were located in Emmet and Cheboygan counties in northern lower Michigan. The bedrock consists of dolomites and limestone, but outcrops are rare and most of the surface is covered by glacial deposits. Seven wetlands were sampled in the summer of 1977. Two were bog sites and were vegetated by tree, tall-shrub, and ground layers. The vegetation in the remaining sites consisted entirely of a ground layer. Two marshes studied did not have a dominant species. In the Hebron Swamp, duckweed was the leading dominant with leatherleaf and cattail condominant. Early to midsummer water levels were well below the surface in the bogs, slightly below the surface at the fens where water was observed at the soil surface at some sample points, and well above the surface in the two marshes and Hebron swamp. The wetlands examined formed three distinct groups with respect to vascular vegetation and midsummer water levels. They formed two distinct groups with respect to chemistry of the standing waters. The similarities and differences between wetland sites were not as great for Protozoa as for vascular vegetation, but the patterns were similar. The open waters at the fed and bog sites and at the Cheboygan marsh may have been highly eutrophic. It was concluded that the structure and dynamics of protozoan communities of wetlands seem to be broadly different from that of other freshwaters, and somewhat unique to particular wetland types. (Baker-FRC)
W82-04927

LIMNOLOGY OF A LARGE, DEEP, NORTH AMERICAN TERMINAL LAKE, PYRAMID LAKE, NEVADA, U.S.A.,
Colorado Cooperative Fishery Research Unit, Fort Collins.
D. L. Galat, E. L. Lider, S. Vigg, and S. R. Robertson.
Hydrobiologia, Vol 82, p 281-317, 1981. 39 Fig, 7 Tab, 156 Ref.

Descriptors: *Saline lakes, *Limnology, *Pyramid Lake, Lakes, *Nevada, Lake stages, Lake morphology.

This paper seeks to update earlier reports on Pyramid Lake and to compare this lake with other athalassic saline lakes and synthesize past studies into a more holistic treatment. Pyramid Lake occupies a large, north-south oriented graben wholly within the boundaries of the Pyramid Lake Paiute Indian Reservation in northwestern Nevada. The eastern shore is abruptly determined by the Lake Range's fault scarp, while the western shore is bounded by the Virginia Range. The headwaters of the Truckee River, the only permanent water source, arise in the Sierra Nevada mountains of eastern California and western Nevada. Although classified as saline, this lake does not fill all the characteristics of that classification. About the only characteristic that the Pyramid Lake shares with all athalassic saline lakes is its lack of outflow. The allochthonous contributions from the Truckee River figure significantly in Pyramid's dynamics. Certainly the reproductive success of the anadromous fishes depends on this river. The composition of the benthic substrate is quite homogeneous, but the shoreline development is high, unlike many other saline waters. The vertical water column provides substantial spatial heterogeneity, not noted in shallower, polymictic saline waters. The lake does not contain a well-developed macrophyte community. It is concluded that the lake does not fix large amounts of energy, providing an exception to the generalization that saline lakes are highly productive. The rich biological community of the lake is a dramatic departure from the low species diversity classically associated with inland saline waters. (Baker-FRC)
W82-04928

ON THE CHEMISTRY OF SOME SALT LAKES AND PONDS IN YUGOSLAVIA,
Bioloski Inst., Belgrade (Yugoslavia).
G. Petrovic.
Hydrobiologia, Vol 81, p 195-200, 1981. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Saline lakes, *Chemical properties, *Yugoslavia, Lakes, Ponds, Magnesium, Calcium, Acidity, Sulfates, Chlorides, Carbonates, *Pannonian plain.

This paper is concerned with some salt lakes and ponds occurring on the Pannonian plain in Yugoslavia. Chemical features are reported of about 75 shallow alkaline lakes and ponds in this region. Geologically the plain represents the evolution of a desiccated basin in which the role of surface and underground water has been significant. Color of the water varied from green to brown. Salinity varied from 0.376 to 13.5%. pH values were seldom below 8.0, being usually between 8.5 and 9.5. All three types of major saline water occurred: carbonate, sulfate and chloride. Sodium bicarbonate and sodium/magnesium bicarbonate waters predominate, and calcium bicarbonate waters were rare. Such chemical diversity reflected the geological nature of the region, the arid climate, the variety in the chemical nature of the soils, the small distance of saline underground water from the surface, and the occurrence of flooding by the Rivers Danube and Tisa. The data reveal that waters on the Pannonian plain outside Yugoslavia have similar ionic compositions to those inside and display a similar range of salinity. It is noted that saline waters of similar chemical composition to those recorded in Yugoslavia occur in many parts of the world. (Baker-FRC)
W82-04929

ALGAL BIOASSAY OF THE WATER FROM TWO LINKED BUT CONTRASTING WELSH LAKES,
University Coll. of North Wales, Bangor. School of Plant Biology.
C. M. Happey-Wood, and A. Pentecost.
Freshwater Biology, Vol 11, No 5, p 473-491, 1981. 8 Fig, 4 Tab, 49 Ref.

Descriptors: *Algal growth, *Lakes, Eutrophication, Nitrogen, Phosphorus, Nutrients, *Bioassay, *Diatoms, Seasonal variations, Thermal stratification, Wastewater, *Wales, Llyn Padarn, Llyn Peris.

Bioassay experiments were conducted for a year using the diatom to assess differences in fertility of water samples from Llyn Padarn and Llyn Peris by growth of Asterionella formosa in filtered water samples and to investigate nutrient limitation by enrichment of these filtered water samples. A rapid bioassay procedure employing C-14 labeled A. formosa was developed as a more sensitive means of assessing the differences in nutrient status of the waters of the two lakes. Water samples were collected every 2 weeks, from a depth of 3 meters. In unenriched water, growth was more rapid in Padarn water during autumn-winter-spring, but there was no significant difference between growth in water from the two lakes during the period of thermal stratification. Mean growth rates in treatments with additions of nitrogen and chelated iron were not significantly different from unenriched water samples, both between treatments and in lakes during thermal stratification. Phosphate additions increased growth in water from both lakes. The potential fertility of water samples from the two lakes differs more during mixed water conditions than in the period of thermal stratification. The addition of diluted sewage effluent which enters the drainage system between the two lakes resulted in similar rates of growth of A. formosa in water from both lakes. (Baker-FRC)
W82-04934

ON THE CHEMISTRY AND BIOTA OF SOME SALINE LAKES IN WESTERN AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Zoology.
M. C. Geddes, P. De Decker, W. D. Williams, D. W. Morton, and M. Topping.
Hydrobiologia, Vol 82, p 201-222, 1982. 6 Fig, 5 Tab, 37 Ref.

Descriptors: *Saline lakes, *Ecosystems, Biota, Salinity, *Australia, *Chemical properties, *Limnology, Lakes, Sodium, Chlorides, Ions.

The limnology of salt lakes in Western Australia was investigated. Water bodies studied were those accessible from the highway between Kalgoorlie, Wiluna, Meekathara, Northam, Lake Grace, Esperance and Norseman, an area of some 800 by 500 km. The study was undertaken in 1978 with about 100 water bodies being sampled. Fifty-four had salinities of 3% or more, and only these are considered in this paper. Crustaceans were by far the dominant group and were represented by twenty-one species of ostracods, ten of anostracans, ten of copepods, three of cladocerans, and one of the Conchostraca and Am phipoda. The halobiont gastropod, Coxiella, was collected from 10 localities. Nematodes were noted in one. No relationship was noted between basin size and fauna. The major factors affecting distribution appeared to be salinity and geographic position. The pattern of major ion dominance was almost always sodium, magnesium, calcium, potassium, and chlorides, sulfate, and bicarbonate in order of decreasing concentrations, with sodium and chloride the dominant cation and anion respectively on all occasions. While this study presents the occurrences of similarities between the fauna of salt lakes in the southwest and southeast of Australia, it also highlights the differences. The most significant result of the studies is the addition of further evidence of greater diversity in the salt lake fauna in the west. (Baker-FRC)
W82-04940

THE LIMNOLOGY OF SALINE LAKES IN WESTERN VICTORIA, A REVIEW OF SOME RECENT STUDIES,
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
Hydrobiologia, Vol 82, p 233-259, 1981. 7 Fig, 5 Tab, 108 Ref.

Descriptors: *Saline lakes, *Limnology, Reviews, *Australia, Seasonal variations, Chemical properties, Acidity, Salinity, Dissolved oxygen, Sedimentation, Lake sediments.

This review considers studies of the major physical, chemical and faunistic features of saline lakes in Western Victoria, but does not consider botanical studies, estimates of primary and secondary production or palaeolimnological findings. The lakes in question lie about 150 km west-southwest of Melbourne in a region known as the Western District of Victoria. Most lakes lie at altitudes of greater than 150 miles above sea level. All are the termini of inland drainage basins, and the area is almost entirely endorheically drained. The climate is temperate, with warm dry summers and cool wet winters. The region is now almost totally used for agricultural purposes. Physical limnology (morphology, temperature, and light), chemical limnology (concentration of dissolved solids, ionic composition, sources of dissolved salts, pH, dissolved oxygen, and sediment composition), and faunal studies (relationship between salinity and occurrence, composition, evolution, adaptations, and seasonal changes) are included in the review. (Baker-FRC)
W82-04942

THERMAL REGIMES OF FLORIDA LAKES, A COMPARISON WITH BIOTIC AND CLIMATIC TRANSITIONS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. R. Beaver, T. L. Crisman, and J. S. Bays.
Hydrobiologia, Vol 83, No 2, p 267-273, 1981. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Lake classification, *Lakes, *Thermal properties, Hydrothermal studies, *Florida, Seasonal variation, Cycling nutrients, Climatic zones, Limnology, Mixing, Water circulation, Lake morphometry, Thermal regimes.

The extent of latitudinal variation in the thermal structure and mixing regime of warm monomictic lakes in Florida is quantified and related to major biotic and climatic zones within the state. Temperature profiles were determined monthly during 1979 for 24 lakes and bimonthly for 5 lakes in peninsular Florida. Zonal thermal differences were nearly eliminated during summer, as evidenced by the fact that August was the only month for which no significant temperature differences existed between any geographic zone, suggesting that differences in the regional thermal regimes of lakes in Florida are related principally to the extent and duration of winter temperature minima. Of 36 statistical comparisons made, only 7 cases displayed a significant temperature difference between shallow and deep lakes for a given month, and no clear trend could be discerned for any lake group. Thus, due to the generally shallow nature of Florida lakes and the less pronounced seasonal temperature fluctuations, basin morphometry does not appear to play as important a role in determining the thermal regimes of Florida lakes as seen for northern lakes. These findings support the contention that the American system for classifying lakes according to their mixing regimes is more concise than the European system but does not provide for transitional lake types. While it is not proposed that the term warm monomictic be revised to formally account for transitional lakes, it is suggested that annual patterns of nutrient cycling and algal productivity in climatically transitional areas such as peninsular Florida may be strongly influenced by intraregional differences in lakes' circulation patterns. (Baker-FRC)
W82-04943

THE DECLINE OF SALVINIA MOLESTA ON LAKE KARIBA,
Lake Kariba Fisheries Research Inst., (Zimbabwe).
B. E. Marshall, and F. J. R. Junor.
Hydrobiologia, Vol 83, No 3, p 477-484, 1981. 3 Fig, 2 Tab, 47 Ref.

Descriptors: *Lakes, *Ecosystems, Eutrophication, *Zimbabwe, *Lake Kariba, Aquatic plants, Salvinia molesta, *Nutrients, Limnology, Reservoir stages, Ferns.

Ecological aspects of Lake Kariba and their possible effects on the decline of Salvinia in Kariba are discussed. During the early post-impoundment years, Lake Kariba was eutrophic as a result of nutrients leached from flooded land, but it rapidly became less eutrophic as these nutrients were lost through the outflow. During this time an explosive growth was noted among several aquatic organisms, of which Salvinia was perhaps the most striking example. The lake reached its full supply level in July 1963, by which time many sheltered areas suitable for Salvinia disappeared and the effects of wave action on the exposed mats became more pronounced. Extensive mats are still found on the lake, but are restricted to the larger estuaries, notably those of the Gachegache, Bumi and Sibilobilo River Basins. No obvious link could be noted between the decline of Salvinia and physico-chemical conditions of the lake. Several factors acting synergistically were probably responsible, including direct attack by Paulinia as well as the indirect effects of competition for nutrients with other ecosystgem components of the developing lake. The ecological effects of the decline of Salvinia on Lake Kariba are not clear. The mats provided a substrate for fish food organisms as well as a cover for various species. Submerged macrophytes will probably fill both of these roles now. The effects on shoreline vegetation will perhaps be more significant. Nutrient retention in the lake, once carried out by the Salvinia, is now carried out more efectively by other ecosystem components. (Baker-FRC)
W82-04945

AN ECOLOGICAL STUDY OF AN ANTARCTIC FRESHWATER POOL WITH PARTICULAR REFERENCE TO TARDIGRADA AND ROTIFERA,
Department of Science, Melbourne (Australia).
D. A. Everitt.
Hydrobiologia, Vol 83, No 2, p 225-237, 1981. 6 Fig, 7 Tab, 54 Ref.

Descriptors: *Lakes, *Polar regions, Antarctic, Benthos, Benthic Environment, Aquatic Life, Biomass, *Rotifers, *Ecology.

This paper records the seasonal population changes of two metazoan groups, rotifers and tardigrades, in a freshwater tarn in Antarctica. Deep Lake Tarn is a small, permanent body of freshwater in the Vestfold Hills, Princess Elizabeth Land, Antarctica. The surface area is 6,200 square meters and maximum depth is 0.45 meters. It is frozen solid for 8 months of the year and is partially or completely melted during the remaining four. Most of the tarn's bottom is a soft, black, anoxic mud overlain with a luxuriant algal carpet. Water was sampled seven times for nutrient analysis from up to seven stations. The benthic algal mat was comprised of cyanophytes, chlorophytes, chrysophytes, a pyrrophyte, rotifers, tardigrades, nematodes, protozoans and bacteria. A sharp rise was noted in all animals when the tarn melted. The ability to cryptobiose or form resistant eggs and the reproductive behavior of tardigrades and rotifers may account for their particular success in the Antarctic environment. A new species of tardigrade (Isohypsibius) is reported. Light intensity ranged from zero in winter to a maximum of 0.22 Langleys/minute during December. Water temperatures ranged from zero to 12.5 degrees C. Nutrient levels were generally similar to those of the sea and other lakes in the area. Nutrients are believed to be of marine origin and transported to the tarn via the meltstream. (Baker-FRC)
W82-04950

A STUDY OF LOW-FLOW OPERATION OF MILFORD AND ELK CITY LAKES IN KANSAS,
Kansas Water Resources Research Inst., L Manhattan.
For primary bibliographic entry see Field 2E.
W82-04964

HYDROLOGIC DESCRIPTION OF LAKE JACKSON, SEBRING, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04975

HORIZONTAL DISTRIBUTION OF CHLOROPHYLL IN THE BIELERSEE (DIE HORIZONTALE VERTEILUNG VON CHLOROPHYLL IM BIELERSEE),
Bern Univ. (Switzerland). Zoologisches Inst.
J. V. Orelli.
Schweizerische Zeitschrift fur Hydrologie, Vol 43, No 1, p 168-175, 1981. 4 Fig, 2 Tab, 6 Ref. English Summary.

Descriptors: *Chlorophyll, *Primary productivity, *Lakes, Algae, Eutrophication, Population dynamics, Limnology, Mathematical studies, Sampling, Variation coefficient, *Bielersee.

One goal of current studies in the Bielersee is that of reliably estimating primary production. The morphology of the lake and the effects of the principal influents imply that samples taken at one point may not be representative. Therefore samples were collected at 0.10 m depth at 15 different points throughout the lake body and analyzed for chlorophyll content. The time-averaged chlorophyll content for the different sites varied from a value of 10.8 mg/cu m with a coefficient of variation of about 50%. No explanation was apparent for the two extremal time averages of 13.2 and 8.8 mg/cu m at two sampling sites. The variation coefficient for the mean chlorophyll contents at all the sampling sites on 14 different dates between April and October 1977 averaged 32%. A clear explanation for the time variation was apparent in the phytoplankton growth stages, which did not occur synchronously throughout the lake. However, the variation between the values at individual sampling sites on individual dates was considerable, and therefore a single value can scarcely be considered representative for the entire lake. The correlations between the 14 measurements at a given site and the values at other sites were analyzed to see whether on site could be selected as optimally representative. In general, the sites near the lake center were most representative. For a reliable representation of algal biomass and primary prductivity throughout the year, it is more suitable to perform frequent measurements at a single site than less frequent measurements at various sites. (Carroll-FRC)
W82-05007

A BUDGET MODEL ACCOUNTING FOR THE POSITIONAL AVAILABILITY OF PHOSPHORUS IN LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W82-05018

SESTON OF THE KREMENCHUG RESERVOIR AND QUANTITATIVE PROPORTIONS OF ITS COMPONENTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. D. Priimachenko, L. E. Mikhailenko, S. L. Gusynskaya, Y. L. Fuksman, and L. I. Pshenichnaya.
Water Resources, Vol 8, No 2, p 186-195, March-April, 1981. 1 Fig, 5 Tab, 14 Ref. Translated from Vodnye Resursy, No 2, p 134-143, March-April, 1981.

Descriptors: *Seston, *Trophic level, *Algae, Eutrophication, Lakes, Detritus, Invertebrates, Zooplankton, Phytoplankton, Cyanophyta, *Kremenchug Reservoir, *Russia, Seasonal variation, Organic matter, Bacteria.

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Seston in Kremenchug Reservoir varied from 2 to 5000 g per cu m dry weight during 1970-72. Seasonal variations in the water column in 1972, a year of lower eutrophication, were 2.2-14.0 g per cu m in spring, 2.4-76.0 g per cu m in summer, and 1.7-13.2 g per cu m in fall. The average seston content (in g per sq m) for the entire reservoir was 52 in May, 133.5 in July, and 35.3 in October of 1972. In July 1971 the average seston concentration in a blue-green algae bloom was 550 g per sq m. In 1972 the relative amount of organic matter in the seston varied from 18 to 52% in May, from 24 to 82% in July, and from 20 to 78% in October. Values were generally higher in the lower and deeper zones than in the upper and shallower zones, as well as in areas where blue-green algae were predominant. During the 1972 vegetative period algae comprised 1.7-82.0% of the organic part of the seston; bacteria, 0.9-74.6%; and invertebrates, 0.001-8.7%. In stretches where young algae predominated, proportions of bacteria in the organic part of the seston were 1-2%. As the algae aged, the bacteria increased to 20-40%. Comparisons with data from other lakes showed that highly eutrophic lakes had 0.04-3.6% zooplankton in the seston, and mesotrophic lakes 7-9.8%. Kremenchug Reservoir had 0.04% zooplankton in a bloom zone in 1970 (whole lake area). There was a correlation between individual components of the organic matter of the seston and between the latter as a whole and its components. (Cassar-FRC)
W82-05029

THE PH HISTORY OF LAKES IN SOUTHWESTERN SWEDEN AS CALCULATED FROM THE SUBSOIL DIATOM FLORA OF THE SEDIMENTS,
Umea Univ. (Sweden). Dept. of Ecological Botany.
I. Renberg, and T. Hellberg.
Ambio, Vol 11, No 1, p 30-33, 1982. 6 Fig, 30 Ref.

Descriptors: *Lakes, *Diatoms, Monitoring, Water quality, Acidity, Acid precipitation, *Sweden, *Sediments, Lake sediments, Sedimentation, *Hydrogen ion concentration, History.

The method of Hustedt's pH-system has been improved and applied in elucidating the pH history of some acidified lakes in southwest Sweden. The lakes studied included Gardsjon, Harsvatten, and Lysevatten, all situated about 10 km east and soouthest of Stenungsund in Bohuslan. The soil in the region is thin, with frequent outcrops of bedrock. The drainage basins of the lakes are forested. Lake shores shelve rather steeply in many places, and the marginal belt of macrophytic vegetation is generally sparse. The composition of the diatom spectrum in a sediment sample depends on the pH of the lake water at the time the sediment was laid down. Diatom samples from the lowermost part of the long sediment core from Gardsjon, representing the transitional zone between the mineral sediments of glacial origin and the true lake sediment, were dominated by a periphytic and relatively acidophilous flora, with many valves of Nitzschia and Fragilaria species. No marine species were found. Six to seven centimeters below the sediment surfaces there was the start of a drastic change in the diatom flora. These lakes came into existence after the deglaciation of the region about 12,500 years ago. The minerogenic sediment in the lowest samples of the long core from Gardsjon was deposited during the final stage of that period. The diatoms in these sediment samples are peryphytic species, many of which are classified as acidophilous, and which are derived both from the lake basin and from the streams and various shallow water bodies. After its formation the lake was more eutrophic than it was later on, and its pH was just below 7. Lakes in Sweden then became more and more oligotrophic and acidic. A sudden fall in pH from 6 to 4.5 during the last few decades, probably due to precipitation falling on the region, has changed the diatom flora dramatically. (Baker-FRC)
W82-05034

SURFACE HEAT FLUXES FROM LAKE ONTARIO: FURTHER VERIFICATION OF LAKE THERMAL MODEL,
Little (Arthur D.), Inc., Cambridge, MA.
W. A. Tucker.
Water Resources Research, Vol 18, No 1, p 77-82, February, 1982. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Heat transfer, *Evaporation, Lakes, *Lake Ontario, *Model studies, Cloud cover, Heat flow, Stratified lakes, Thermal properties.

A one-dimensional heat transfer/thermal structure model was used to estimate the components of heat flux at the surface of Lake Ontario during July-October 1972. Model inputs were lake geometry, water optical properties, and surface weather observations. Comparisons of the heat flux components with estimates obtained from observations showed that the next flux was accurately predicted by the model, but the radiative input to the lake was significantly overestimated. This error was a result of a deficiency in the expression accounting for the effect of cloud cover on insolation. Errors in sensible and latent heat fluxes were compensating, producing an accurate value for net heat flux. Evaportation rates predicted by the model were 50% higher than an average of estimates obtained using seven other methods. (Cassar-FRC)
W82-05048

METABOLIC ACTIVITY OF HERBIVOROUS ZOOPLANKTON IN LAKE KINNERET (ISRAEL) DURING 1972-1977,
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Journal of Plankton Research, Vol 3, No 1, p 15-24, 1981. 5 Fig, 5 Tab, 19 Ref.

Descriptors: *Zooplankton, *Lakes, *Biomass, *Metabolism, *Food chains, Grazing, Water temperature, Aquatic productivity, Aquatic populations, Respiration, Aquatic animals, *Lake Kinneret, *Israel.

The metabolic activities of the herbivorous grazer zooplankton community in Lake Kinneret, Israel were studied from 1972 to 1977. For most years, two peaks for metabolic activity were found: the first in May-June and the second in October-November. Two distinct metabolic periods were found during the entire study period, namely from January 1972 to June 1974 and from June 1974 to December 1976. In 1974-1975, there was a significant increase in the sardine (Mirogrex terraesanctae-terraesanctae) population. The herbivore communities were reduced by Mirogrex during June 1974-1976. The high summer temperatures of the epilimnic water caused increased respiration rates from July through November. The late summer-early fall peak of zooplankton biomass is probably due to a slowing of Mirogrex feeding or an increase in water temperature. Seasonal cumulative food consumption, respiration, productivity, and defecation values for 1975-1977 were lower than 1972-1974 values. The highest defecation activity occurred during April-June when a high level of inedible material was present in the lake. No significant increases in relative and absolute densities of larval stages were found in 1975-1977 compared to 1972-1974. It was likely that the grazed food increased in nutritional value between 1974 and 1975. (Geiger-FRC)
W82-05074

NUTRIENT DISTRIBUTION IN NORTH GERMAN LAKE SEDIMENTS AND REMARKS ON SEDIMENT-PELAGIC EXCHANGE (DIE NAHRSTOFFVERTEILUNG IN SEDIMENTEN NORDDEUTSCHER SEEN UND HINWEISE AUF DEN AUSTAUSCH SEDIMENT-PELAGIAL),
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geookologie.
G. Mothes.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 35-46, 1980. 6 Fig, 1 Tab, 10 Ref. (No English summary).

Descriptors: *Lake sediments, *Cycling nutrients, *Lakes, Limnology, *Germany, Phosphorus, Eutrophication, Productivity, Nutrients, Sediments, Chemical composition, Stagnant water.

As part of a large-scale research program on material dynamics in lakes and wetlands of North Germany (centered on Stechlin Lake), investigations were conducted on nutrient distribution and transfer in lake sediments. Sediments are closely involved in the questions of nutrient resupply for primary production, persistence of sedimented seston, and stability of water bodies relative to environmental events. Sediment samples were collected at maximum depths from lakes Stechlin, Nehmitz (north and south basins), Grosse Fuchskuhle, Dagow, Jabel (central and northern basins) and Globsow. These lakes represented oligotrophic and eutrophic, low and high productivity, and overfertilized types. Fractions of dry matter, ash mass, calcium carbonate, carbon, nitrogen, phosphorus and silica in the sediments were analyzed. The phosphorus distribution in the sediment was found to represent the most useful indicator of lake status. In addition to total phosphorus, the ratio of phosphorus in interstitial water to particulate fraction and the ratio of orthophosphate to total phosphate in the interstitial water play an essential role. An increase in C:P ratio in an eutrophicated water body occurs during restoration, with carbon oxidation in the sediment. Because of the stabilizing effect of lake sediments, lake restoratin by cleanup of inputs or supplemental aeration takes decades to become significant, while eutrophication can occur in a few years. Specific sediment conditions for the individual lakes are discussed. (Carroll-FRC)
W82-05091

DECOMPOSITION OF UREA BY SIZE-FRACTIONATED PLANKTONIC COMMUNITY IN A EUTROPHIC RESERVOIR IN JAPAN,
Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh.
Hydrobiologia, Vol 83, No 1, p 153-160, 1981. 3 Fig. 3 Tab, 34 Ref.

Descriptors: *Reservoirs, *Plankton, Phytoplankton, Lakes, Bacteria, Seasonal variations, *Urea, *Biodegradation, Microbial degradation, Kinetics.

Phytoplankton is usually considered responsible for most of the urea decomposition occurring in natural waters. Free bacteria had been found to be inactive for urea decomposition in previous studies. In the present study, free bacterial populations were separated from an intact planktonic community in water of a eutrophic reservoir in Japan by filtration through Whatman GF/C glass fiber filters (mean porosity .2 micron). Urea decomposition by the free bacterial populations and the intact planktonic community was determined in six different months. The count of free heterotrophic bacteria increased during the urea decomposition experiments, but the urea concentration did not decrease. Thus, the separated free bacteria apparently did not take part in urea decomposition. On the other hand, urea was decomposed by the intact planktonic community in five out of six cases. The phytoplankton in the sixth case was hypothesized to have been in a sensecent state. Thus it appears that phytoplankton were responsible for most of the urea decomposition. Rate constants were calculated at 0.00-0.63/day with a mean value of 0.21/day, assuming that urea decomposition obeyed first-order kinetics. (Baker-FRC)
W82-05095

THE MICROFAUNA OF ALGAL MATS AND ARTIFICIAL SUBSTRATES IN SOUTHERN VICTORIA LAND LAKES OF ANTARCTICA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. D. Cathey, B. C. Parker, G. M. Simmons, Jr., W. H. Yongue, Jr., and M. R. Van Brunt.
Hydrobiologia, Vol 85, No 1, p 3-15, 1981. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Cold regions, *Aquatic fauna, *Species composition, *Lakes, Iced lakes, Glacial lakes, *Antarctica, *Algal mats, Benthic fauna, Southern Victoria Land, Protozoa, Rotifers, Tardigrades, Invertebrates.

This paper reports results of the first study of the microfaunal community inhabitating the littoral and benthic zones of eight Antarctic dry valley

lakes. General taxonomic compositions were given for six lakes and detailed community composition analyses for two lakes. Four major faunal groups were identified on algal mat samples and artificial polyurethane foam substrates: protozoa, rotifers, tardigrades (Hypsibus antarcticus), and nematoes (rare and not further identified). The lakes differed in limnological properties and in distribution ofmicrofauna. Protozoans were the most diverse, with 88 taxa belonging to 40 genera identified in Lakes Fryxell and Hoare in 1978-79. The most productive lake, Fryxell, had the greatest number of protozoan taxa (55). The shallow Lake Chad also had an abundant microfaunal community in comparison with the other lakes. For the first time, dinoflagellates (Gymnodinium andd Glenodinium) were identified in this region. Since all lakes had similar temperature and light regimes, the differences in faunal composition in these remote Antarctic lakes were probably caused by the variations in physical and chemical properties of the lakes. The distribution of the fauna followed patterns similar to those seen in temperature lakes. (Cassar-FRC)
W82-05096

DIEL VARIATIONS OF CERTAIN PHYSICO-CHEMICAL PARAMETERS OF WATER IN SELECTED AQUATIC SYSTEMS,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy.
Hydrobiologia, Vol 85, No 3, p 201-207, 1981. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Diel variatins, *Physicochemical properties, *Seasonal variation, Water hyacinth, Ponds, Ammonium, Nitrates, Phosphates, Bicarbonates, Carbonates, Hydrogen ion concentration, Dissolved oxygen, Eutrophic lakes, Elodea, Cattails, *Lake Apopka, *Florida, Lakes, Macrophytes, Algae, Vegetation effects, Nutrients, Water quality.

Diel variations in physical and chemical parameters were determined in waters from a drainage canal containing water hyacinth (floating plant), a water hyacinth pond, an elodea (submerged plant) pond, a cattail (emersed plant) pond, a pond without aquatic macrophytes (control), and eutrophic Lake Apopka, Florida. Parameters measured in the October, January, May, and July (1979-80) samplings were dissolved oxygen, pH, dissolved carbon dioxide, bicarbonate and carbonate alkalinity, ammonium-N, nitrate-N, phosphate-P and conductivity. Water in hyacinth ponds showed little or no diel or seasonal variation in dissolved oxygen, pH, dissolved carbon dioxide and bicarbonate alkalinity. In aquatic systems with no floating vegetation (elodea, cattail, control, and Lake Apoka) dissolved oxygen increased to a high of 5-20 micrograms per ml at midday and decreased to 2-8 micrograms per ml at night. The pH of the waters ranged from 8-9.5 during midday to 7-8 at night. In systems with no floating vegetation bicarbonate levels decreased during daylight and carbonate levels increased. An inverse relationship between carbonate and bicarbonate alkalinity was seen at night. No carbonates were detected in the water hyacinth ponds. No diel variations in N (ammonium and nitrate) or P (phosphate) were observed in any systems. (Cassar-FRC)
W82-05097

MINERAL COMPOSITION OF PHRAGMITES AUSTRALIS IN SCOTTISH LOCHS AS RELATED TO EUTROPHICATION. I. SEASONAL CHANGES IN ORGANS,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
Y. B. Ho.
Hydrobiologia, Vol 85, No 3, p 227-237, 1981. 3 Fig, 7 Tab, 48 Ref.

Descriptors: *Seasonal variation, *Nutrients, *Eutrophication, *Lakes, Aquatic plants, Eutrophied lakes, Trophic level, Plant physiology, Reeds, *Scotland, Phragmitess australis, Forfr Loch, Balgavies Loch, Lowes Loch.

Levels of N, P, K, Na, Ca, Mg, and Fe in root, rhizome, stem, leaf, and panicle of the common reed (Phragmites australis) were determined monthly from March to November 1975 in 3 Scottish lakes: Forfar (very eutrophic), Balgavies (eutrophic), and Lowes (mesotrophic). Mineral levels in root, rhizone, and panicle showed no consistent seasonal changes. Aboveground organs, the leaf in particular, had higher levels of ash, N, K, Ca, and Mg than the belowground parts; the reverse was true for Na and Fe. The concentrations of N, P, K, Ca, and Mg in stem and leaf rose to a peak before they declined for the remainder of the growth period. Peaks were in April, May, June, September, or October depending on the part of the plant and the particular mineral. Plants in Forfar, the most eutrophied lake, contained significantly higher levels of tissue N, P, K, and Ca than plants from less eutrophied lakes (Cassar-FRC)
W82-05099

CHEMISTRY, PHYSICS AND EVOLUTION OF ANTARCTIC SALINE LAKES,
H. R. Burton.
Hydrobiologia, Vol 82, p 339-362, 1981. 4 Fig, 2 Tab, 206 Ref.

Descriptors: *Lakes, *Polar regions, Reviews, Nutrients, Seasonal variations, *Saline lakes, *Chemical properties, Hydrology, Evolution, Antarctic.

This review deals with Antarctic saline lakes, discussing specifically the history and evolution of coastal lakes, South Victoria land lakes, the source of water, major ions and dissolved gases present in the water, minor ions present, nutrients and organic matter, light, temperature, stability, water circulation, hydrology, and future work needed in this area. Many of the well developed characteristics of Antarctic saline lakes are related to the extreme seasonal range in solar radiation levels. These characteristics include thick and sometimes permanent ice cover which can ensure long-lasting meromixis, low water temperatures in hypersaline lakes, and usually, oligotrophy. (Baker-FRC)
W82-05100

PHOTOSYNTHETIC ACTIVITY OF PHYTOPLANKTON IN TROPICAL AFRICAN SODA LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Hydrobiologia, Vol 81, p 72-85, 1981. 8 Fig, 9 Tab, 39 Ref.

Descriptors: *Lakes, *Plankton, *Phytoplankton, *Photosynthesis, Africa, Tropical regions, Soda lakes, *Kenya, Limnology, Diurnal variations, Chlorophyll.

A comparative analysis is presented of the variability of photosynthetic activity during an 18-month period in four Kenyan soda lakes. Three aspects of the photosynthetic activity of phytoplankton are presented: the diurnal and month-to-month changes in photosynthetic activity in two contrasting lakes; the photosynthetic rates and phytoplankton abundances in these two lakes and in additional tropical African soda lakes; and the relations among photosynthetic activity, insolation and efficiency of light utilization for tropical soda lakes. These four lakes encompass most conditions present in the soda lakes of Africa. Lakes Elmenteita and Bogoria are broad, shallow lakes lying in tectonic basins associated with fault scarps. Lakes Simbi and Sonachi occupy small, moderately deep volcanic explosion craters. All four lie in semi-arid basins of internal drainage and their levels fluctuate considerably. The biota includes few species and phytoplankton are usually the major primary producer. To appreciate fully the amplitude and patterns of variability in photosynthetic activity and to determine how ecological factors influence photosynthesis required measurements on time scales from minutes to years. Even in time intervals of only hours, days and months, significant variability was noted. Chlorophyll a concentrations measured in the study varied over 200-fold. While Lake Sonachi had a low rate of photosynthesis, Lake Simbi had exceptionally high rates. A possible explanation is the lower chlorolphyll a concentration in Lake Sonachi, which may be due to a lower rate of supply of nutrients. In general a direct correlation was noted between photosynthetic efficiency of light utilization and photosynthetic rates. (Baker-FRC)
W82-05101

LIMNOLOGICAL STUDY OF A FRESHWATER RESERVOIR, JAMWA RAMGARH (JAIPUR).
Rajasthan Univ. Jaipur (India). Dept. of Botany.
B. Gopal, P. K. Goel, K. P. Sharma, and R. K. Trivedy.
Hydrobiologia, Vol 83, No 2, p 283-294, 1981. 8 Fig, 6 Tab, 20 Ref.

Descriptors: *Limnology, *Reservoirs, Monitoring, Lakes, Water supply, Water quality, Jamwa Ramgarh, Jaipur, *India, Eutrophication, *Semiarid lands.

This paper documents some data on the human activities in the catchment area of, and limnology of a reservoir in the semiarid region of India, along with observations on the recent influences of human activities on the water quality. Jamwa reservoir was constructed by damming the river Banganga, which originates in the midst of the Aravalli ranges in district Jaipur at about 16 km northwest of Manoharpura. The reservoir has a total catchment area of 769 square kilometers which is bounded on all sides by hills of the Aravalli ranges, up to several hundred meters in height. The reservoir is triangular in shape, with maximum length of 7 km and maximum breadth of about 3.5 km. Surface area at the full level is 12.69 square kilometers. Maximum and mean depth are 18 and 4.6 meters, respectively. The reservoir harbors a rich phytoplankton flora; however, it is not rich in fauna. The reservoir is the main source of drinking water supply for the city of Jaipur, supplying about 8 million gallons per day or about 40% of the total water requirement. Forest cover is present in 19.5% of the catchment area, while 25.7% is under irrigated cultivation and the rest is either fallow land or cultivable waste land or not available for agriculture. Accelerated denudation of the vegetation around the reservoir has resulted due to increased numbers of people living there. After remaining oligotrophic during 75 years of its existence, the reservoir is now showing signs of eutrophication. The data collected will help in monitoring the future changes in water quality, an urgent need. (Baker-FRC)
W82-05102

EPILIMNETIC AND HYPOLIMNETIC SYMPTOMS OF EUTROPHICATION IN GREAT MAZURIAN LAKES, POLAND,
Warsaw Univ. (Poland). Chair of Hydrobiology.
Z. M. Gliwicz, and A. Kowalczewski.
Freshwater Biology, Vol 11, No 5, p 425-433, 1981. 5 Fig 1 Tab, 12 Ref.

Descriptors: *Lakes, *Eutrophication, *Poland, *Limnology, Lake morphology, Lake stages, *Great Mazurian Lakes, Epilimnion, Thermal stratification, Oxygen requirements.

An analysis of the long term changes in epilimnetic and hypolimnetic symptoms of eutrophication was performed on data for the Great Mazurian Lakes, a complex of connected lakes with a total area of 310 square kilometers and water flow of low intensity, directed both north and south away from the channel connecting Lake Niegocin with the northern part of the complex. An increase in the rate of eutrophication occurred, beginning in the 1950s with an intensification of agriculture, recreational development and the general expansion of towns. The values of the absolute oxygen deficit, during the analyzed period of time, ranged from 0.037 to 0.132 and from 1950 to 1077 they ranged from 0.049 to 0.132 mg oxygen/square centimeter/day, indicating the sutrophic character of all the lakes studied. For Mamry Polnocne, which is a mesotrophic lake according to SDI data, the value of the absolute oxygen deficit was 0.078-0.125, suggesting it is eutrophic in character. The Secchi disc readings converted to values of SDI show that there was a relatively rapid increase in the trophic state of the lakes studied after 1950, which is comparable with the SDI change in Lake Washington in

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the same period. In spite of morphometric similarity, which is important for the intensity of internal loading, smaller lakes advanced their trophic state quicker than larger ones, as each unit of their surface was exposed to more allochthonous input from the neighboring area of their direct drainage basins and from their proportionally larger total drainage basins. Their flushing rates, higher than larger lakes, did not tend to weaken the symptoms of eutrophication. The different thermoclines in smaller vs larger lakes may also be an important factor in determining the rate of hypolimnetic eutrophication. (Baker-FRC)
W82-05103

BIOMASS AND ANNUAL PRODUCTION OF THE FRESHWATER MUSSEL ELLIPTIO COMPLANATA IN AN OLIGOTROPHIC SOFTWATER LAKE,
Cornell Univ., Ithaca, NY.
D. L. Strayer, J. J. Cole, G. E. Likens, and D. C. Buso.
Freshwater Biology, Vol 11, No 5 p 435-440, 1981. 4 Fig. 1 Tab, 22 Ref.

Descriptors: *Lakes, *Ecosystems, *Biomass, Mussels, Aquatic life, Oligotrophic lakes, Trophic cycle, Oligotrophy, *Mirrow Lake, *New Hampshire.

Data on the distribution and abundance of a freshwater mussel in Mirror Lake, New Hampshire, are presented with particular reference to the importance of this mussel in the ecosystem of the lake. Mirror Lake is a small oligotrophic lake in the White Mountains. Its water is clear and soft. From July to September of 1978 and 1979 divers with SCUBA swam transects at 80 meter intervals around the entire lake, and at 40 meter intervals in regions of high clam population density. E. complanata was not abundant in Mirrow lake. It reached maximum density between 2 and 3 meter depths and was most common in gently sloping sandy areas. Only 3% of the biomass and 116% of the annual production are in the younger age-classes. It appears that E. complanata may live to be 16-18 years old in the waters. Therefore, while E. complanata population forms a considerable part of the benthic biomass between 1 and 4 meters depth, it appears to play a trivial role in the functioning of the ecosystem, with its annual production being only about 0.1% of the total macrobenthic production. (Baker-FRC)
W82-05104

DOWNCORE VARIATION IN SEDIMENT ORGANIC NITROGEN,
Case Western Reserve Univ., Cleveland, OH, Dept. of Geological Sciences
J. B. Fisher, G. Matisoff, and W. J. Lick.
Nature, Vol 296, No 5855, p 345-347, March 25, 1982. 2 Fig, 15 Ref.

Descriptors: *Nitrogen, *Sediments, *Deposition, *Lake Erie, Lakes, Sedimentology, Lake sediments, Organic compounds, Particulates, Fate of pollutants, *Core sampling, *Temporal distribution.

A procedure for calculating historical depositional flux (loading record) is given for a substance which undergoes post-depositional chemical reaction in a compacting sediment column. Lake Erie sediments were analyzed for organic nitrogen, whose vertical distribution depends solely on the depositional flux of particulate organic nitrogen and the post-depositional rate of microbial decomposition. Net ammonium production was used as a measure of the destruction of particulate organic N. As a result, the rates are minimal, not including possible conversion to other N species. Results indicate that the loading of organic N to the sediments at this locality increased since 1950. The flux of particulate organic N was 0.165 mol per sq m per year in 1820-60 and 0.285 mol per sq m per year in 1974-77, giving a ratio of anthropogenic to natural loading of 0.73. Inclusion of the decomposition factor in calculations of N loading produces lower ratios of apparent anthropogenic contributions of N than obtained in previous work. This method may also be applied to reactive materials such as P and C. (Cassar-FRC)
W82-05124

INITIAL MICROBIOLOGICAL RESPONSE IN LAKES TO THE MT ST HELENS ERUPTION,
Oregon State Univ., Corvallis. School of Oceanography.
J. A. Baross, C. N. Dahm, A. K. Ward, M. D. Lilley, and J. R. Sedell.
Nature (London), Vol 296, No 5852, p 49-52, March, 1982. 2 Fig, 2 Tab, 32 Ref.

Descriptors: *Lakes, *Succession, *Volcanoes, *Water pollution effects, Photosynthesis, Bacteria, Population dynamics, Denitrification, Eutrophication, Oligotrophic lakes, Anaerobic conditions, Hydrobiology, *Microbiological studies, *Mt St Helens.

Little information exists on the early stages in the establishment and succession of aquatic microbial communities and other related chemical and geochemical transformations shortly after a volcanic eruption. The chemical, microbial and hydrothermal responses of lakes affected by the May 18, 1980 eruption of Mount Saint Helens were examined 3 to 4 months after the eruption. The impacted lakes were ultraeutrophic, anaerobic and contained extensive bacterial populations, some not common to the area. By August of 1980, the extent of chemosynthetic , photosynthetic, and heterotrophic activity on the lakes was regulated by both the assimilative and dissimilative nitrogen cycles. Oxygen production by photosynthesis, denitrification and anaerobic oxidation of reduced metals, gases, and organic compounds will aid in restoring the lakes to their normal oligotrophic state.(Geiger-FRC)
W82-05125

KINETICS OF NUTRIENT AND METAL RELEASE FROM DECOMPOSING LAKE SEDIMENTS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, J. B. Fisher, and P. L. McCall.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2333-2347, December, 1981. 7 Fig, 6 Tab, 64 Ref.

Descriptors: *Lake sediments, *Decomposing organic matter, *Nutrients, *Metals, Bottom sediments, Temperature effects, Kinetics, Decomposition, Stochastic process, Model studies, Anaerobic conditions, *Lake Erie, Great Lakes.

Incubation tests with sealed sediment sections from Lake Erie were conducted to determine the rates of anaerobic decomposition for seven depth intervals at three temperatures. The interstitial waters were serially sampled over a period of about 200 days. Concentration increases of bicarbonate, phosphate, ammonium, calcium, magnesium, iron, and manganese in pore water within any given depth interval followed zero order kinetics over the sampling period and exhabited Arrhenius temperature dependency. The rates of release to the pore waters were proportional to the concentrations in the solid phases, indicating first order kinetics overall. The observed release rates decreased exponentially with depth in the sediment due to a corresponding decrease in the amount of metabolizable organic matter and acid hydrolyzable mineral phases. A model was constructed to predict the stoichiometry of the decomposing organic matter and the nature of the hydrogen buffer. The modelling indicates that 60% of the observed bicarbonate release is the direct result of organic decomposition, with the remainder due equally to the dissolution of calcium carbonate mineral phases and to the dissolution of manganese, iron, and magnesium carbonate mineral phases. Kinetic modelling of the observed production rates accurately predicted the vertical profiles of calcium, magnesium, iron, and manganese, but did not quantitatively account for all the concentration differences of carbon, nitrogen, and phosphorus, suggesting that increased depositional flux may partly account for the significant changes in concentrations of these nutrient elements in the near surface sediments. (Carroll-FRC)
W82-05139

CYANOBACTERIAL BLOOMS: CARBON AND NITROGEN LIMITATION HAVE OPPOSITE EFFECTS ON THE BUOYANCE OF OSCILLATORI,
State Univ. of New York Coll. at Purchase.
For primary bibliographic entry see Field 5C.
W82-05175

INCORPORATION OF CHEMICAL EQUILIBRIUM, PHYSICO-CHEMICAL REACTIONS AND THE SIMULATION OF INORGANIC QUALITIES IN A RESERVOIR ECOLOGIC MODEL,
Texas Univ. at Austin. Dept. of Civil Engineering.
L. W. K. Lum, N. E. Armstrong, and E. G. Fruh.
Ecological Modelling, Vol 14, No 1, p 95-123, 1981. 22 Fig, 7 Tab, 13 Ref.

Descriptors: *Simulation analysis, *Mathematical studies, *Reservoirs, *Ecology, Chemical reactions, Physicochemical properties, Water quality.

An existing ecological model, LAKECO, was modified and expanded to include physico-chemical reactions including chemical equilibrium between inorganic species and the addition of six inorganic variables that may be of significance in water supply and ecological cycles. LAKECO is a water quality reservoir model consisting of 18 variables which undergo predominantly biochemical-biological reactions. The chemical equilibrium program which was added distributes total concentrations of inorganic variables into free, complexed, and precipitate forms. The six inorganic variables added to the original 18 are calcium, magnesium, iron, silicate, sulfate, and fluorine. The physico-chemical reactions incorporated into the model include precipitation and resolubilization, diffusion of ions from sediments or weathering, complexation, and adsorption of phosphorus onto calcium and iron precipitates and bottom sediments. Two original variables in LAKECO, total dissolved solids and alkalinity, were converted to non-conservative substance. Data from Lake Lyndon B. Johnson, in Texas, were used to calibrate and validate the new, expanded model. The calibration results indicated that chemical equilibrium was a proper assumption on some occasions, such as the simulation of surface phosphorus, but not in others, such as pH. Consideration of the zero-order diffusion of ions from sediments was found to be appropriate in simulating phosphate-phosphorus, ammonia nitrogen, silicate, calcium, magnesium, and iron. The new model allows good simulation of algae. (Carroll-FRC)
W82-05187

EFFECTS OF INCREASED ATMOSPHERIC C02 ON GREAT LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie.
In: Workshop on Environmental and Societal Consequences of a Possible C02-Induced Climate Change, Annapolis, Maryland, April 2-6, 1979. Department of Energy Report CONF-7904143, October 1980, p 237-249. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Carbon dioxide, *Great Lakes, *Calcium carbonate, *Hydrogen ion concentration, *Water temperature, Mathematical models, Model studies, Alkalinity, Productivity, Light penetration, Nutrients, Environmental effects, Ecological effects.

Regular occurrences of green or milky water in several of the Great Lakes has been termed whiting. Seasonal whiting in Lakes Michigan, Ontario and Erie is the result of autogenic precipitation of calcite, caused by the seasonal patterns in temperature and pH. Increasing levels of atmospheric carbon dioxide will lead to laterizations in the aquatic inorganic carbon cycle. An inorganic carbon model based on known PC02 concentrations, constant alkalinity, and constant calcium was

analyzed for the effects of increasing PC02. The model was run at 5 degrees C temperature increments from 0-25 degrees C and at PC02 concentrations of 290 (representing pre-industrial concentrations), 330 (approximate current concentration), 660, 990, and 1980 parts per million. Hydrogen ion concentration will increase with increased carbon dioxide, driving the pH down by approximately 0.3 units by the time the current atmospheric carbon dioxide concentration doubles and by approximately 0.5 at three times the present concentration. At twice the present level, the ratio of the ion activity product of calcium and carbonate divided by the solubility product of calcite will have dropped to 50% of its current value, and at three atmospheres of carbon dioxide the ratio will have dropped below the critical saturation level in Erie and Ontario and be barely supersaturated in Michigan. The overall indication is that the increase in atmospheric carbon dioxide will inhibit the formation of the lakewide whiting of calcium carbonate. The ecological consequences are postulated to be increased productivity due to removal of light backscatter by calcite particles and removal of the mechanism of micronutrient absorption. (Moore-SRC)
W82-05209

THE ECOLOGY OF SOUTHERN CALIFORNIA COASTAL SALT MARSHES: A COMMUNITY PROFILE,
San Diego State Univ., CA. Dept. of Biology.
J. B. Zedler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-205717, Price codes: A06 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-81/54, March 1982. 119 p, 49 Fig, 19 Tab, 180 Ref.

Descriptors: *Coastal marshes, *Wetlands, *Ecology, *Marsh management, *Salt marshes, Tidal marshes, Salinity, Flooding, Productivity, Halophytes, Algae, Vegetation, Fauna, Hydrology, Tidal effects, Rainfall, Lagoons, *California.

Southern California coastal marshes are confined to narrow stream outlets along a coastline of rugged topography and continuing geological activity. Tidal sea water is the major source of moisture throughout all but the brief winter wet season. Extreme variations in intertidal soil salinities occur between years of flooding and drought. Lagoon closures cause additional variability in salinity. Freshwater input stimulates germination of most halophytes and flooding events appear to be important for establishment and expansion of species distribution. The net annual productivity of the marsh vascular plants tends to be under 1 kg/sq m/yr. The low-growing, open canopies of vascular plants allow light penetration to the soil surface and subsequent development of lush algal mats. Halophytes probably decompose before being consumed by marsh animals, therby funneling much of their carbon to microbes, while algae are grazed directly by snails, crabs, and topsmelt. Marsh vegetation provides a refuge and food for the native invertebrates, birds and small mammals. Much of the region's wetlands acreage has been destroyed. Management problems include continuing development, reduced tidal circulation, depauperate species lists, and the need to create marsh communities on newly exposed substrates. (Moore-SRC)
W82-05215

MICROBIAL ECOLOGY OF PECTIN DECOMPOSITION IN ANOXIC LAKE SEDIMENTS,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
B. Schink, and J. G. Zeikus.
Journal of General Microbiology, Vol 128, Part 2, p 393-404, 1982. 5 Fig, 2 Tab, 44 Ref.

Descriptors: *Organic matter, *Decomposition, Sedimentation, Sediments, Lakes, *Lake sediments, *Eutrophication, Methanol, Acetate, Pectin, Anaerobic digestion, Bacteria, Lake Mendota, Knaack Lake, *Wisconsin.

The study was performed to characterize the decomposition of pectin and anaerobic pectinolytic population in two freshwater lake sediments and to document the metabolic interactions between prevalent pectinolytic bacteria and other sediment bacteria that account for complete anaerobic mineralization of the polymer. Lake Mendota is a moderately eutrophic, hard water lake, of glacial origin. Knaack Lake is a eutrophic, meromictic lake. The turnover times for pectin biodegradation to methane in sediments incubated at in situ temperatures were much than that observed for glucose or previously reported for acetate. The numbers of pectinolytic anaerobes varied seasonally in both sediments and were highest during the fall after sedimentation of algal blooms and/or leaf detritus. Clostridium butyricum was identified as a prevalent pectinolytic anaerobe in both lakes. In monoculture pectin fermentations, C. butyricum produced methanol, acetate, ethanol and butyrate. Growth stopped in the presence of excess energy source when the pH fell to 4.3. In co-culture pectin fermentations of C. butyricum/Methanosarcina barkeri, methanol and acetate were detected as intermediary metabolites and pectin was completely degraded to methane and carbon dioxide, the pH remaining neutral. During co-culture growth on pectin the concentration of methanogenic substrates is limited by the rate of pectin conversion and the rate of intermediary metabolite consumption. (Baker-FRC)
W82-05275

DO MODEL FOR DISCHARGES FROM DEEP IMPOUNDMENTS,
Tennessee Valley Authority, Chattanooga.
J. M. Higgins, and B. R. Kim.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 107-122, February, 1982. 6 Fig, 3 Tab, 34 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Impoundments, Reservoirs, Oxygen, Mathematical models, Turbines, Biochemical oxygen demand, Temperature effects, Thermal stratification, Seasonal variations, Deep water.

This paper presents a simple model for the annual dissolved oxygen (DO) cycle of releases from the hypolimnion of deep impoundments. This model includes mathematical formulations and rate constant for the processes of biochemical oxygen demand (BOD) decay, atmospheric reaeration, and thermal stratification. The model was used to characterize the DO cycle of releases from 17 Tennessee Valley Authority reservoirs, using three years of weekly DO and temperature data. Rate constants were estimated using the quasilinearization technique for estimating unknown parameters in a system of ordinary differential equations. The results of the study indicate that the model can reasonably simulate annual DO variations of turbine discharges from hypolimnetic waters. Since the model is a simple formulation of complex reservoir processes, it is best suited for preliminary analyses. Future applications of the model would be improved by better data on: inflow BOD and DO concentrations, in-lake BOD variations with time, internally generated BOD, and surface water temperature. The use of weekly flow rates and reservoir volumes and annual rate constant values should also improve the simulation of DO variations from year to year. (Baker-FRC)
W82-05316

HETEROTROPHIC ASSIMULATION OF PHYTOPLANKTON AS AN INTEGRAL PART OF THE SELF PURIFICATION OF NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 1A.
W82-05326

HYPANIA INVALIDA IN THE VOLGA RESEVOIRS AND HYDROBIOLOGICAL MONITORING,
N. A. Dzuban, and N. B. Slobodchikov.
Hydrobiological Journal, Vol 16, No 5, p 49-52, 1980. 1 Tab, 22 Ref.

Descriptors: *Hypania, *Reservoirs, *Fish food organisms, Benthic fauna, Invertebrates, *Volga River, *USSR, Self-purification.

Hypania invalida, a polychaete, was introduced as fish fodder into Kuybyshev Reservoir on the Volga River in 1959-67. It was first found near the Kuybyshev Dam in 1977 at a depth of 25 m on silted bottom material at 1000 specimens per sq m. In 1978 it was found at concentrations of 20 specimens per sq on sandy bottom material and 1280 specimens per sq m on silted bottom material. Many specimens were slightly larger (14 mm) than the 12 mm noted in the identification key for the region. Hypania has also been found in the Saratov River and other places in the Volga River system. The organism colonized in a downstream direction from Kuybyushev Reservoir, rather than upstream from the Volga delta, where it is indigenous. In addition to serving as a food resource for fisheries, Hypania and the related Monodacna may help to stabilize the food resources of benthophages. Studies are underway regarding the relation of Hypania to the saprobicity indices and to reservoiir self-purification processes. (Cassar-FRC)
W82-05331

SOME DATA ON THE FAUNA AND ECOLOGY OF METOPIDAE (INFUSORIA) IN KIEV RESERVOIR,
A. A. Koval'chuk.
Hydrobiological Journal, Vol 16, No 5, p 38-44, 1980. 2 Fig, 1 Tab, 34 Ref.

Descriptors: *Species composition, *Lake sediments, *Benthic fauna, Sediments, Reservoirs, Infusoria, Metopids, Invertebrates, *Kiev Reservoir, *USSR.

The composition of the metopid population in Kiev Reservoir indicated that the reservoir is in a satisfactory sanitary state. Altogether 28 species of metopids, 11 of them new to the USSR, were found in 1977-79. The abundance of M. spinosus was greatest in July-September, when water was warmest. A new species, M. tortus pulcher var. tortus, was noted. A new variant was M. setifer var. ovata, and two new forms were M. liminarius f. minima (small and lacking elongated cilia at the posterior) and Brachonella undulans f. tetracilliata (small, truncated posterior and few caudal cilia). The numbers and diversity of these species depend on water quality factors, especially food and temperature factors, but also trace element levels. The metopids are tolerant of hydrogen sulfide. The fact that metopids were not dominant in any instance investigated in associations of Infusoria confirms the satisfactory water quality conditions in this reservoir. (Cassar-FRC)
W82-05332

STATE-OF-THE-ART OF MODELING SURFACE WATER IMPOUNDMENTS,
Nevada Univ. System, Reno. Water Resources Center.
P. A. Krenkel, and R. H. French.
Water Science and Technology, Vol 14, No 1/2, p 241-261, 1982. 8 Fig, 5 Tab, 43 Ref.

Descriptors: *Model studies, *Water quality, *Reservoirs, Lakes, Mathematical models, Hydrodynamics, Water circulation, Aquatic life, Phosphorus, Algae, Dissolved oxygen, Nitrates, Phytoplankton, Ammonia, Zooplankton, Mixing.

Modeling of surface water impoundments, which began in 1920, received impetus in the 1960's from the development of large computers and from the growing awareness of the environment. Since then, reservoir modeling has reached a sophisticated level. One-, two-, and three-dimensional models with many water quality parameters are available. Although the hydrodynamic aspects of the models are reasonably satisfactory, the water quality parameters need further development. In general, models which have been formulated by biologists tend to ignore or simplify the importance of water circulation and mixing, whereas models developed by engineers slight the biological subtleties. The best water quality model lies between the two extremes. When only a few parameters are of interest, simple models may be used in place of complicated, general models. Although most models apply to the pelagic zone, the public is generally interested in the littoral zone, which has

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not been subjected to modeling. At this stage in model development the knowledge of physical and biological systems lags behind computer capability. (Cassar-FRC)
W82-05351

THE STRUCTURE OF CRUSTACEAN ZOOPLANKTON COMMUNITIES IN GLACIATED EASTERN NORTH AMERICA,
Guelph Univ., (Ontario). Dept. of Zoology.
J. C. Roff, W. G. Sprules, J. C. H. Carter, and M. J. Dadswell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1428-1437, November, 1981. 2 Fig, 7 Tab, 38 Ref.

Descriptors: *Glacial lakes, *Zooplankton, *Population dynamics, Lake classification, *Crustaceans, *Species composition, Species diversity, Geology, Regional analysis, North America, Eastern North America.

Since recent studies of the relationship between the structure of freshwater zooplankton communities and physicochemical features of lakes in North America have been made in restricted geographical areas of rather homogeneous character, it has not been possible to determine whether or not species associations tend to vary among regions. Data from 522 lakes of glaciated eastern North America were examined to determine what species coexist and in what combinations and to study possible reasons for the observed patterns of existence. Glacial influence was found to be the primary determinant of zooplankton community structure in these lakes. Use of this criterion resulted in successful discrimination of 82% of the lakes between glacial lakes, to which Diaptomus sicilis, Limnocalanus macrurus, Mysis relicta, and Senecella calanoides were restricted, and nonglacial lakes, of which Cyclops scutifer, Eubosmina longispina, Daphnia pulex, D. catawba, and other species were characteristic. A third large group of common species was distributed throughout the study area with no particular relation to glacial lake influence. There were no clear patterns in community structure with respect to size of zooplankters. Most of the species distributions or abundances were not consistent with the well-known predatory and competitive interactions among zooplankters typical of small lakes and ponds. It is suggested that this resulted partly from the use of large and heterogeneous study area and partly because the biological interactions observed in small lakes and ponds may be less intense in the more physically complex environment of large lakes. (Carroll-FRC)
W82-05379

THE CHEMISTRY OF SUSPENDED MATTER IN ESTHWAITE WATER, A BIOLOGICALLY PRODUCTION LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,
Edinburgh Univ. (Scotland). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-05416

THE ROLE OF AGRICULTURAL SEDIMENTS AND CHEMICALS IN EUTROPHICATION,
Iowa State Univ., Ames. Dept. of Animal Ecology.
R. W. Bachmann.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2425-2431, 2600, October, 1980. 2 Tab, 28 Ref.

Descriptors: *Eutrophication, *Lakes, Rivers, Nutrients, Model studies, Reviews, Environmental effects, Limnology, Lake stages, Lakes, *Chemical composition, *Agricultural runoff, *Sediments.

Basin concepts are reviewed concerning the trophic state of lakes, the eutrophication process, and the role of point and nonpoint sources of nutrients and sediments. The need for specific research on the effectiveness of nonpoint pollution controls is presented. Oligotrophic is the classification applied to those lakes with the smallest concentrations of plant nutrients and the least biological productivity. Eutrophic lakes such as Lake Mendota in Wisconsin have high levels of plant nutrients and high levels of biological productivity. The term mesotrophic is sometimes applied to lakes intermediate between oligotrophic and eutrophic, while ultraoligotrophic and hypereutrophic are sometimes used for lake on the extreme ends of the scale. While many lakes were originally oligotrophic, they have become eutrophic over the years. Lakes influenced by human activity have undergone eutrophication in the period of a few decades, much quicker than lakes out of the reach of man's influence. The high levels of algae in eutrophic lakes make the cost of treatment to obtain desired water quality from the lake much higher. Phosphorus is extremely important in lake restoration programs, not only because it is important as a limiting nutrient, but also because of its chemical nature. Point sources have been responsible for the most publicized cases of cultural eutrophication such as Lake Zurich, Lake Erie and Lake Washington. There are additional problems with lakes that have been heavily loaded for periods of time. Flowing water systems are much more difficult to deal with than lakes. There is little accumulation of nutrients over time as the water is continually moving through the system. Different types of models are used for lakes and rivers. (Baker-FRC)
W82-05447

INTERRELATIONSHIPS IN THE DEVELOPMENT OF THE THREE STRUCTURAL COMPONENTS OF THE PLANKTON IN THE OFF-BOTTOM ZONE OF LAKES,
Belorussian State Univ., Minsk (USSR).
V. A. Babitskiy, T. M. Mikheyeva, and G. A. Inkina.
Hydrobiological Journal, Vol 17, No 1, p 8-14, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Phytoplankton, *Zooplankton, *Bacterioplankton, Biomass, Nutrients, Temperature effects, Plankton, Lake beds, *Trophic level, Population dynamics, Limiting factors, Bottom water, Mesotrophic lakes, Eutrophic lakes, Comparison studies, *USSR.

A study was made of zooplankton, phytoplankton and bacterioplankton in a thin zone close to the bottom of the mesotrophic Lake Naroch, the eutrophic Lake Myastro and the highly eutrophic Lake Batorin. Research was conducted in the lakes from May 1970 to May 1971. The mean abundance of all groups of the plankton increased in a regular manner from the mesotrophic Lake Naroch to the highly eutrophic Lake Batorin. Research was conducted in the lakes from May 1970 to May 1971. The mean abundance of all groups of the plankton increased in a regular manner from the mesotrophic Lake Naroch to the highly eutrophic Lake Batorin. The same species were dominant in the zooplankton of all the lakes. Blue-green algae were less abundant in the zone near the bottom of Lakes Naroch and Myastro than in the pelagic zone. In Lake Batorin the bulk of the phytoplankton biomass in the zone near the bottom was largely Ceratium and blue-green algae, but in the pelagic zone exclusively blue-green algae. Throughout the study the biomass of fodder phytoplankton in Lakes Naroch and Myastro altered only slightly, invariably remaining at a fairly low level. The biomass of the filter feeders was higher over the vegetation season than that of fodder phytoplankton, and in Lake Myastro was also higher than that of bacterioplankton. The low biomass values of fodder phytoplankton and their slight fluctuations in Lakes Naroch and Myastro confirm the previous suggestion that interrelationships between the zooplankton and its food are evidently strained in the zone near the bottom of the lakes. Detritus must play an appreciable role in the consumption of the zooplankton of these areas. The temperature factor has appreciably influenced the development of first-order and second order consumers, of fodder phytoplankton, and of bacterioplankton in Lake Myastro. Food may not be a limiting factor in the development of planktonic filter feeders in highly eutrophic lakes. (Baker-FRC)
W82-05451

AN ELECTRON MICROSCOPIC STUDY OF THE FORMS OF BACTERIA IN THE SURFACE FILM OF THE WATER,
Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
Ye. A. Lepilova, and V. A. Gavrilova.
Hydrobiological Journal, Vol 17, No 1, p 27-30, 1981. 2 Fig, 7 Ref.

Descriptors: *Reservoirs, *Bacteria, *Surface water, Lakes, Water quality, Seasonal variations, *Microbiological studies, Air-water interfaces, *USSR.

A method is presented for producing bacterial preparations for electron microscopy studies by placing electron microscope grids in the surface film of the water to pick up fouling. This method was used to study the microflora of the surface film. Research was carried out at the Rybinsk Reservoir in May, August and September of 1978. Water samples were taken at six stations in the open part of the reservoir and in the inshore zone. The studies showed that the bulk of the bacteria in the surface film of the water, both in the inshore zone and in the open part of the reservoir, and rod-shaped bacteria and cocci, members of the genus Caulobacter. Rod-shaped forms constitute the overwhelming majority in the surface film in all experiments. Most often they are in clusters, sometimes joined into chains, but solitary forms are also encountered. Rare species were more frequently found in the inshore zone than in the central part of the reservoir. Only filamentous forms were found in the open part of the reservoir. Smaller rod-shaped bacteria were sometimes parasitic on filamentous forms. The most varied microflora in the surface film of the water in the inshore zone was recorded in August, which is also the time of maximum production of organic matter through the photosynthesis of algae. (Baker-FRC)
W82-05452

THE FORMATION OF WATER QUALITY IN THE SHALLOWS OF A SOUTHERN RESERVOIR (DNIEPER-KRIVOI ROG CANAL) UNDER THE INFLUENCE OF BEDS OF HIGHER AQUATIC VEGETATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. B. Korsak, and V. K. Myakushko.
Hydrobiological Journal, Vol 17, No 1, p 37-42, 1981. 2 Tab, 17 Ref.

Descriptors: *Water quality, *Reservoirs, Lakes, Aquatic plants, Biomass, Seasonal variation, *Yuzhnoye Reservoir, USSR.

Changes in water quality were investigated in the Dnieper-Krivoi Rog Canal reservoir, called the Yuzhnoye. The reservoir has a water area of 11.03 square kilometers, a volume of 57.3 million cubic meters, and a mean depth of 5.2 meters, with a maximum depth of 26 meters. Aerial-aquatic plants play the major role both in overgrowth and in the formation of primary production. The effect of higher water plants on water quality was investigated. The water quality in the shallows of Yuzhonoye Reservoir extensively involved higher water plants and was dependent on the composition of the communities, their productivity, the stage of phenological development of the plants and the extent of the flow through the overgrown areas. The most favorable hydrochemical conditions during the period of study were noted in the highly productive beds of aerial-aquatic vegetation, through which there was no flow. When macrophyte production was moderate and flow through the shallows was adequate, water quality in the communities of aerial-aquatic vegetation did not alter appreciably, and in the summer was often better than in the open areas. The effect of the submerged vegetation on the hydrochemical regime of the shallows during the vegetation period was generally positive, with the oxygen saturation of the water in the weed beds reaching 135%, the content of dissolved biogenic matter being lower than in the plant-free areas as a result of its active consumption by plants, the concentration of organic compounds not exceeding the standards for maximum permissible concentrations, and partial decalcination of the water in a number of instances in the absence of carbon dioxide and high pH values. (Baker-FRC)
W82-05453

PLANKTONIC INFUSORIA AS INDICATORS OF THE EXTENT OF ORGANIC POLLUTION IN AZERBAIDZHANIAN RESERVOIRS,
Akademiya Nauk Azerbaidzhansjoi SSR, Baku. Inst. Zoologii.
I. K. Alekperov.
Hydrobiological Journal, Vol 17, No 1, p 57-42, 1981. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Reservoirs, *Water quality, Oxygen, Oxidation, Aquatic plants, *Plankton, Azerbaidzhanian Reservoirs, Indicators, *Organic pollution, Pollutant identification, *USSR.

An account is given of the extent of organic pollution in three Azerbaidzhanian reservoirs - the Mingechaur, Varvara and Dzheyranbatan. Date was collected seasonally from 1972 through 1974. Sixty species of Infusoria were recorded as indicators of different degrees of saprobicity in the plankton of all the reservoirs investigated. Each reservoir belonged to the beta-meso and alpha-mesosaprobic zones as regards the degree of organic pollution, as the indicators of these zones accounted for between 64 and 76% in each of them. The main reason for the heavier pollution in the upper part of the reservoir is the water of the rivers supplying it. The pollution of the Khanabad part was due to rotting organic matter accumulating in it. The upper part of the Varvara Reservoir was the cleanest part of the reservoirs examined. The inshore zone of the Varvara Reservoir was the most polluted, being used by the inhabitants for watering cattle. The number of indicator species of the alpha-meso-polysaprobic zone found here was 8%. The middle part of the Dzheyranbatan Reservoir was the cleanest part of this reservoir. Of the total of indicator Infusoria recorded in it, 78% belong to the oligo-beta-mesosaprobic zones. Indicators of the alpha-meso-polysaprobic zone were also recorded in the inshore area of these parts, in the upper part accounting for 4% of the total, in the lower part for 6%. Consequently, ecological analysis of the Infusoria of Mingechaur, Varvara and Dzheyranbatan reservoirs shows that their water belongs in the main to the mesosaprobic zone, that is, there is adequate oxygen in the water, and mineralization takes place by the total oxidation of organic matter. (Baker-FRC)
W82-05454

SALT AND TRACE ELEMENT COMPOSITION OF THE WATER OF LAKE MALINOVOYE (ALTAI TERRITORY); AS A HABITAT OF ARTEMIA SALINA,
Lvov Univ., (USSR).
N. S. Yalynskaya, and I. V. Strubitskiy.
Hydrobiological Journal, Vol 17, No 1, p 73-77, 1981. 2 Tab, 23 Ref.

Descriptors: *Chemical composition, *Lakes, Aquatic life, Crustaceans, *Salinity, Sodium chloride, Magnesium, Sediment, *Lake Malinovoye, *Trace elements, Aquatic environment, Water quality, Water analysis, Biological samples, Sediment samples, *USSR.

Samples of water, bottom material and specimens of Artemia salina were collected from Lake Malinovoye during July of 1978 and 1979. The water was quite highly saline, with the principal salt being sodium chloride. The water was shown to contain 20 components, the bottom material 26. Artemia was represented by four physiological groups in the samples from the lake. Females molting with undiscarded exuviae, females between the period of molts and oviferous, sexually mature females in the period between molts without eggs, and mature molted females with soft integuments made up the four groups. The morphological structures responsible for maintaining the water and salt balance are manifested in response to the distinctive ionic-salt composition of the habitat of the halobiont Artemia salina. Under the conditions of Lake Malinovoye, the development and growth of Artemia salina took place with a small quantity of calcium cation and in the absence of the salt, calcium carbonate. As in other water bodies, A. salina in Lake Malinovoye needed sodium chloride as its principal salt. Magnesium was apparently a vitally important ion for Artemia salina. (Baker-FRC)
W82-05455

MUTUAL FLOCCULATION OF ALGAE AND CLAY: EVIDENCE AND IMPLICATIONS,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
Y. Avnimelech, B. W. Troeger, and L. W. Reed.
Science, Vol 216, No 4541, p 63-65, April 2, 1982. 2 Fig, 14 Footnotes.

Descriptors: *Flocculation, *Algae, *Clays, Aggregates, Turbidity, Anabaena, Chlorella, Chlamydomonas, Sedimentation, Clarification, Lakes, Water quality management.

Algae-clay aggregates were formed in the presence of a critical concentration of electrolyte, 0.005 M for CaC12 and 0.02 M for NaCl. Algae were not flocculated in the absence of clay under the conditions studied. Flocculation patterns of the algae were biphasic. In the first phase (at the lower clay concentrations) increasing the clay concentrations sharply increased the degree of flocculation. Further increases in clay concentration after a certain point produced little additional flocculation. The maximum ratios of clay to algae in the particles were 1.7, 0.2, and 0.03 (wet weight) for Anabaena, Chlamydomonas, and Chlorella, respectively. Eglena gracilis had little tendency to flocculate. The variability in flocculating potential among the different algae is probably affected by composition and properties of the cell wall, extent and type of secretions, physiological conditions, and age. Algal-clay flocculation may be useful in water quality management. For example, turbid water could be clarified by promoting algal growth, or algal-rich water could be clarified by addition of clay to the water. Sedimentation of algae leads to a downward displacement of nutrients. Filter feeders such as silver carp can only use particles larger than 20-50 microns; therefore, algae too small to be trapped may be used if aggregated with clay. (Cassar-FRC)
W82-05460

BIOASSAYS AND THE ALGAL POPULATIONS OF HASTINGS LAKE, ALBERTA, CANADA,
Zurich Univ. (Switzerland). Hydrobiology-Limnology Station.
F. Schanz.
Water Research, Vol 16, No 4, p 441-447, April, 1982. 4 Fig, 2 Tab, 42 Ref.

Descriptors: *Bioassay, *Biomass, *Algal growth, *Anabaena, *Eutrophic lakes, *Limiting nutrients, Eutrophication, Cyanophyta, Lakes, Iron, Phosphorus, Nutrients, Temperature, Weather, Aquatic populations, Species composition.

A set of experiments was carried out to investigate the success of introducing Anaebaena clones into untreated waters of Hastings Lake, Alberta, Canada to establish this species as the dominant indigenous plankton population. Experiments were carried out in the summer of 1978 on the biomass development of the eutrophic lake, and bioassays were performed on untreated water, water inoculated with Anabaena flos-aquae, and filtered or autoclaved water. Bioassays on untreated Hastings Lake water showed good correlations with the biomass developments in the lake. Nutrient levels were assessed by bioassays with unialgal cultures in filtered or autoclaved water samples. During the summer months, iron and/or phosphorus seemed to be important limiting nutrients for algal growth in Hastings Lake. Results of competition experiments failed to render conclusive information upon which to base predictions about the future development of Anabaena on the lake. Some effects of weather on algal production are discussed. (Geiger-FRC)
W82-05484

INDOLES IN THE DECOMPOSITION PRODUCTS OF CERTAIN BLUE-GREEN ALGAE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. V. Arendarchuk.
Hydrobiological Journal, Vol 17, No 1, p 50-53, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Algae, *Decomposition, Eutrophication, Degradation, Indoles, Lakes, Dissolved solids, Seston.

An attempt was made to elucidate the dynamics of the concentration of indole compounds and to identify such compounds in the decomposition products of seston collected in a water body during the mass bloom of blue-green algae. The research was conducted on seston consisting as to 80-90% of Microcystis aeruginosa and Aphanizomenon flos-aquae. The content of indoles in the water increased following the decomposition of the organic matter of dying cells of blue-green algae to a certain level, after which it declined as a result of mineralization. Temperature had an appreciable effect on the decomposition of the algal mass and the formation of indole-containing compounds. Chromatographic separation of the decomposition products of the algal mass showed that various substances entered the water in appreciable amounts. Among the decomposition products of the algal mass were found two indole compounds and one phenol compound. One of the indole compounds found on the chromatograms was verified, it was established that zones corresponding to indole compounds stimulated the growth of wheat coleoptiles. The maximum stimulation was given by the indole-acetic acid zone. The zone corresponding to the phenol compound inhibited growth. Consequently, phenol and indole compounds entered the water on the death and post mortem decomposition of the organic matter of the blue-green algae that cause the algal bloom. These compounds have a growth-stimulating activity. (Baker-FRC)
W82-05505

THE IMPORTANCE OF LACUSTRINE ZOOPLANKTON TO THE FEEDING CAPACITY OF THE LIZHMA LAKE-RIVER SYSTEM (BASIN OF LAKE ONEGA).
Akademiya Nauk USSR, Petrozavodsk. Inst. of Biology.
A. N. Kruglova.
Hydrobiological Journal, Vol 17, No 1, p 15-20, 1981. 4 Fig, 2 Tab, 24 Ref.

Descriptors: *Lakes, *Zooplankton, Rivers, Lake Kedra, Kedra River, Lake Tarasm, Fish food, Plankton, Biomass, Aquatic fauna.

The object of this study was to establish the part played by zooplankton carried out of lakes in providing food resources for the spawning and growing reaches of salmon rivers. Research was carried out in the lower reach of the Lizhma, covering 4.3 km from its outflow from Lake Kedra to the mouth, location of the main spawning grounds of valuable food fishes such as salmon, whitefish, and trout. Observations and data were collected during the open water period of May through October in the years 1972 and 1973 and every 10 days at 6 permanent stations during 1976 and 1977. A total of 78 species of plankton organisms were found in the investigated part of the Lizhma River. There were more crustaceans and Rotatoria, members of the weekbedbank complex, in the plankton of the river reaches than in the lake reached. These species are particularly plentiful in calm reaches of the river with developed aquatic vegetation. The potamoplankton in the Lizhma River mostly originate from the lakes. The main sources for the development of the plankton are Lake Kedra and Lake Tarasm. The plankton fauna of the river rapids consist mainly of Rotatoria, the smaller Copepods, and some species of Cladocera. The species and quantitative indices of the zooplankton vary with distance from the outflow from the lakes. The parts of lake-river system below the lakes are the most productive. An appreciable amount of plankton is carried out of Lake Kedra and lake Tarasm. The plankton flow is greatest in the main in the summer months. Zooplankton carried out of the lakes is utilized by juvenile fishes and benthic invertebrates, and helps to increase the density of the drift, the main food for juvenile salmon. (Baker-FRC)
W82-05508

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TRANSPORT PROCESSES OF COPPER AND ZINC IN A HIGHLY EUTROPHIC AND MEROMICTIC LAKE,
Eidgenoessische Anstalt fuer Wasservorgung, Abwasserreinigung und Gewaesserschutz, Kastienbaum (Switzerland). Lake Research Lab.
For primary bibliographic entry see Field 5B.
W82-05518

EVALUATION OF FOURTEEN TROPHIC STATE INDICES FOR PHYTOPLANKTON OF INDIANA LAKES AND RESERVOIRS,
Notre Dame Univ., IN. Dept. of Biology.
P. F. Sullivan, and S. R. Carpenter.
Environmental Pollution, Series A, Vol 27, No 2, p 143-153, February, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Lakes, *Phytoplankton, *Reservoirs, *Trophic level, Water quality, Water analysis, Lake classification, Algal growth, Eutrophication, Plankton, Indiana, Statistical analysis, Diversity indices, Species diversity.

Principal components analysis (PCA) was used to examine the relationships of fourteen phytoplankton trophic state indices to forty-two samples from Indiana lakes and reservoirs. The goals of the study were to determine which groups of indices were redundant and which indices were most diagnostic of the various classes of sample that emerged from the PCA. Twenty-seven Indiana lakes and reservoirs, each downstream of a sewage treatment plant outfall, were sampled in the spring, summer and autumn of 1973. The results indicated that diversity indices were not useful of trophic classification, as they are not monotonically related to degree of eutrophication and require more data for their calculation than other indices. Nygaard's indices were often undefined, and therefore unusable, because the denominator was zero. Palmer's genus index was more sensitive to differences among samples than Palmer's species index. Of the indices examined, two were relatively useful - Palmer's genus index, which reflects the abundance of eutrophic indicator genera, and the concentration of the most abundant taxon, which is sensitive to bloom samples. (Baker-FRC)
W82-05579

EFFECT OF THE SPRING FLOOD REGIME ON THE DEVELOPMENT OF NORTH CASPLAN ZOOBENTHOS,
Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
For primary bibliographic entry see Field 2E.
W82-05596

MICROSCALE PATCHINESS OF NUTRIENTS IN PLANKTON COMMUNITIES,
Michigan Univ., Ann Arbor.
J. T. Lehman, and D. Acavia.
Science, Vol 216, No 4547, p 729-730, May 14, 1982. 1 Tab, 15 Footnotes.

Descriptors: *Nutrients, *Algae, *Population dynamics, Phosphorus, Plankton, Phytoplankton, Zooplankton, Daphnia, Chlamydomonas, Lakes, Species composition.

Unstirred cultures containing zooplankton (Daphnia) labeled with P33 and algae (Chlamydomonas) were compared with stirred cultures by autoradiographic techniques. In the unstirred vessels, which simulated the natural microscale (mm or less) patchiness of nutrient distribution, algae augmented their cell quota of P33 as much as 12% per encounter. Apparently the nutrient patches produced by excretion of P by the zooplankton exist long enough for algae passing through to absorb more nutrients than do algae outside the patches. These conditions favor development and survival of algal types which can quickly acquire nutrients from the short-lived nutrient patches existing in otherwise nutrient-poor waters. (Cassar-FRC)
W82-05613

PRELIMINARY INVESTIGATION OF THE ALGAL FLORA IN THE SEDIMENTS OF LAKE ERIE,
State Univ., of New York Coll. at Buffalo. Great Lakes Lab.
For primary bibliographic entry see Field 5C.
W82-05633

STABILITY EFFECTS ON GREAT LAKES EVAPORATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D.
W82-05634

WATER QUALITY MODELING OF LAKE MICHIGAN AND CONSIDERATION OF THE ANOMALOUS ICE COVER OF 1976-1977,
Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W82-05638

WETLANDS AND DEEPWATER HABITATS: A NEW CLASSIFICATION,
Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
For primary bibliographic entry see Field 2L.
W82-05716

SELECTING A METHOD FOR ESTIMATING SUBSTANCE LOADINGS,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 5B.
W82-05746

EFFECTS OF WATERHYACINTH ON THE PHYSICOCHEMISTRY OF A SOUTH GEORGIA POND,
Clemson Univ., SC. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-05809

AGE, SPACING AND GROWTH RATE OF TAMARIX AS AN INDICATION OF LAKE BOUNDARY FLUCTUATIONS AT SEBKHET KELBIA, TUNISIA,
University Coll., London (England). Dept. of Botany and Microbiology.
F. B. Goldsmith, and N. Smart.
Journal of Arid Environments, Vol 5, No 1, p 43-51, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Lakes, *Tamarisk, Phreatophytes, Tunisia, Saline lakes, Population densities, Floods, Boundaries, Water boundary, Sebkhet Kelbia, Wildlife habitats, Evapotranspiration.

Measurements were made of the population structure, growth rates and spacing of tamarisk in the northeast corner of Sebkhet Kelbia, a shallow evaporative lake in central Tunisia. The area chosen for intensive study is a considerable fringing zone of tamarisk; the zonation was clear. This was also near the point where outflow occurs during the large flood events. The tamarisk varied considerably in density, intensity of grazing and height, so a stratified method of sampling was employed to investigate the range of variation. The oldest bushes in the sample examined were only 8 years old. The distribution of stems between age classes approximated a normal curve with a mean aroung 1974/75 and a range of 6 years. This type of distribution would only be expected if the tamarisk were being harvested or had been destroyed in a catastrphic event such as the 1969 and 1973 floods. Since the colonization and age structure of the population postdates the 1969 and 1973 floods, it can be assumed that the areas were last inundated during these events. The annual growth rates since that time indicate a period of relative inactivity from the hydrological viewpoint, with continued shrinkage of the lake and encroachment of the fringing lake vegetation. Areas of dead Typha which mark former lake levels were being colonized by tamarisk as evidence of this encroachment. Tamarisk in the future is likely to increase in extent, and its ecological effects upon the area deserve further attention. (Baker-FRC)
W82-05877

2I. Water In Plants

WATER MANAGEMENT OF WHEAT IN HEAVY CLAY SOILS OF MADHYA PRADESH,
Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
S. S. Tomar, R. K. Gupta, and A. S. Tomar.
Indian Journal of Agricultural Sciences, Vol 51, No 7, p 493-497, July, 1981. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Water use efficiency, *Irrigation, *Crop yield, *Wheat, Clays, Irrigation efficiency, *India, Grain crops, Water management, Soil-water-plant relationships.

Wheat (Triticum aestivum-Linn. emend. Thell.) grown on heavy clay soil of central Madhya Pradesh, India, was irrigated 1 to 4 times during the growing season during a study in 1974-77. Treatments were: T1 irrigation at preemergence; T2, T1 plus 1 irrigation at crown root initiation; T3, T2 plus 1 irrigation at tillering; and T4, T3 plus 1 irrigation at flowering. The crop receiving 4 irrigations (t4) produced the highest yield of grain, 43.45 q per ha. Lowest yield was produced by treatment T1,26.70 q per ha. Water use efficiency was highest with treatment T1 (105-123 kg per ha per cm) and decreased with increasing mumber of irrigations to 97-105 kg per ha per cm for T4. This was a result of the higher residual moisture left unused in the profile and deep percolation losses. Moisture regimes of less than 40 cm in a 150 cm profile adversely affected water used by the crop. (Cassar-FRC)
W82-05119

EFFECT OF MOISTURE LEVELS IN VEGETATIVE AND REPRODUCTIVE PHASES OF WINTER-SOWN MAIZE ON GRAIN YIELD, IRRIGATION REQUIREMENT AND WATER-USE EFFICIENCY,
Rajendra Agricultural Univ., Samastipur (India).
D. P. Singh, S. D. Prasad, U. K. Prasad, and N. N. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 861-864, December, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Irrigation requirements, *Water use efficiency, *Corn, Irrigation efficiency, Soil-water-plant relationships, *India, Grain crops, Crop yield.

Maize (Zea mays Linn.) was planted in the winters of 1976-77 to 1978-79 at Dholi, India, to determine the irrigation requirements. Irrigations were scheduled when the available soil moisture (ASM) in the top 0-30 cm soil layer reached 70,50, and 30% in the vegetative and reproductive phases separately. Maximum yield of 57.3-68.8 q per ha was produced by irrigation at 70% ASM in the vegetative phase and 50 or 70% ASM in the reproductive phase. Water use efficiency increased with the drier regimes. These results suggest that the optimum irrigation regime for winter-sown maize in this region would be 5 or 6 irrigations (intervals of 30-34 days) to produce 70% ASM in the vegetative phase and 50-70% ASM in the reproductive phase. This recommendation applies for the seasonal rainfall range of 66-173 mm. (Cassar-FRC)
W82-05120

INFLUENCE OF SEASONAL EVAPORATIVE DEMAND ON EVAPOTRANSPIRATION AND YIELD OF IRRIGATED WHEAT,
Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 2D.
W82-05121

EFFECT OF PLANT POPULATION AND NITROGEN ON WATER-USE EFFICIENCY OF

PEARLMILLET IN THE ARID ZONE OF WESTERN RAJASTAN,
Central Arid Zone Research Inst., Jodhpur (India).
A. Krishnan, S. D. Singh, and A. S. R. A. S. Sastri.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 865-870, December, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Irrigation, *Water use efficiency, *Fertilizers, Millet, *India, Crop yield, Grain crops, Water management, Nitrogen, Arid lands, Evapotranspiration, Consumptive use, Soil-water-plant relationships.

Seasonal consumptive use by rainfed pearl miller (Pennisetum typhoides Burm. f.) was studied at 10 and 20 cm plant spacing and nitrogen additions of 0 to 120 kg per ha. The experiment was conducted during 1974, 1975, and 1977 when annual rainfall amounts in this arid region of India were 67%, 178%, and 95% of normal (366.9 mm). Seasonal consumptive uses at 10 cm spacing were 223, 253, and 247 mm at N additions of 0, 60, and 120 kg per ha, respectively. Seasonal consumptive uses at 20 cm spacing were 213, 210, and 289 mm at the same N addition regimes, respectively. Water use efficiency (in kg grain per mm evapotranspiration) was highest with 60 kg N per ha (5.38) followed by 4.83 for 120 kg per ha N, and 3.54 at no added N. Water use efficiencies for the two plant spacings were almost the same. Results of predictions of the soil moisture storage with consideration of initial soil moisture storage by the climatic water budget method (Thornthwaite and Mather, 1955) agreed well with observed values, but the conventional prediction method underestimated soil moisture storage. (Cassar-FRC)
W82-05122

DEEP DRAINAGE AND WATER USE OF FORESTS AND PASTURES GROWN ON DEEP SANDS IN A MEDITERRANEAN ENVIRONMENT,
Alcoa of Australia, Pinjarra.
For primary bibliographic entry see Field 4B.
W82-05629

MEASUREMENT AND MODELLING OF PRIMARY PRODUCTION AND WATER USE IN A SOUTH TUNISIAN STEPPE,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 2D.
W82-05876

2J. Erosion and Sedimentation

SEDIMENT TRANSPORT AND SHOALING IN ESTUARINE AND OTHER SHALLOW-WATER AREAS,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W82-04753

MODELING: HOW AND WHEN TO USE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W82-04754

MOVEMENT OF DIFFUSE SOURCE POLLUTANTS IN SMALL AGRICULTURAL WATERSHEDS OF THE GREAT LAKES BASIN,
Michigan Agricultural Experiment Station, East Lansing.
For primary bibliographic entry see Field 5B.
W82-04856

STABLE-CHANNEL DESIGN IN GRAVEL-BED RIVERS,
Ministry of Works and Development, Christchurch (New Zealand).
For primary bibliographic entry see Field 2E.
W82-04865

STORM SEDIMENT CONCENTRATIONS AS AFFECTED BY LAND USE, HYDROLOGY, AND WEATHER,
West Virginia Univ., Morgantown. Dept. of Chemical Engineering.
F. H. Verhoff, and S. M. Yaksich.
Journal of Environmental Quality, Vol 11, No 1, p 72-78, January-March, 1982. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Sediment transport, *Storms, *Suspended sediment, Temperature effects, Seasonal variations, Erosion, Rainfall-runoff relationships, Lakes, *Lake Erie, Water pollution sources.

A study is reported of suspended sediment transport to Lake Erie. Two types of analyses are reported: time variations and hydrologic variations. The principal variable used is an average suspended sediment concenration, computed by summing the suspended sediment transported during a given time period, divided by the water discharge during the same time period. From the total phosphorus data on the Sandusky River, it is concluded that 3 or 4 years of data are not sufficient to determine the effect of point source abatement in an agricultural watershed. Hydrology and weather are the major factors affecting the storm average suspended sediment concentration in the Maumee River at Waterville. Important variables are maximum discharge during the storm, storm duration, water temperature and high wind average for the days since the previous storm. Raindrop impact and rain energy do not explain the variation in the suspended sediment concentration at Waterville on the Maumee River. Maximum dischage has a positive influence on storm average suspended sediment concentration because higher velocities are able to carry greater concentrations of sediment. Storm duration is significant in a negative way on concentration because longer storms tend to have declining stages during which the suspended sediment concentration is lower. Water temperature's positive influence may be due to microbial activity in the river bottoms. The dependency of the average storm suspended sediment concentration on the maximum discharge is nearly the same for all seasons of the year. (Baker-FRC)
W82-04878

THE INFLUENCE OF WATER SALINITY ON PALUDAL EROSION PROCESSES,
New Orleans Univ., LA. Dept. of Geography.
N. L. Froomer.
Journal of Geology, Vol 90, No 2, p 179-185, March, 1982. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Salinity, *Soil erosion, Water quality, River banks, *Mississippi River Delta, Geology, Marshes, Aquatic plants, *Environmental effects, *Salt marshes.

This paper investigates the influence of water salinity on marsh erosion processes. Laboratory experiments were constructed to determine the influence of water salinity on the erodibility of three different coastal marsh soils from the Lake Pontchartrain-Lake Borgne area of southeastern Louisiana. Site 1 was located in a brackish environment where vegetation is dominated by the grass Spartina alterniflora, producing a coarse but interconnected underground matrix of large diameter roots and rhizomes. Site 2 was in a slightly brackish environment near the mouth of Bayou Lacombe with Spartina patens dominating the vegetation, producing a tightly interwoven underground matrix of thin, fibrous rhizomes. The third site was in a slightly brackish to fresh environment with spartina cynosuerdes vegetation, which does not produce an underground framework of interconnected rhizomes. Although the influence of salinity varied in different soils, erodibility generally decreased as the water salinity was increased from 0 to 10%. The field evidence from the Mississippi River delta indicates that most rapid erosion occurred where and when water salinity was lowest, given the same wave energy. Salinity is believed to influence marsh erodibility due to the influence of salt concentration of electrical field interactions among soil colloids. (Baker-FRC)
W82-04995

BED LOAD FLUCTUATION: APPLICATIONS,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
H. Qiwei, and H. Mingmin.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 199-210, February, 1982. 2 Tab, 4 Ref.

Descriptors: *Sediment transport, *Mathematical studies, *Bed load, *Fluctuations, *Sediment erosion, Sediment load, Sedimentation, Model studies, Mathematical equations, Streambeds, Stream profiles, Stream erosion, Sediments, Erosion, *Particle size, Sampling.

Research on the mechanism of bed load movement is important in interpreting hydrological measurements. The sampling duration under various conditions should be recorded so that the measured transport rate may be obtained with sufficient accuracy. Derivations are examined for the variance and coefficient of variation of transport rate for uniform and nonuniform sand with determinate and random size distributions over a pebble bed. Due to frequent deposition and erosion, along with apparent sorting, the particles become more uniform at certain locations. The relationship between the coefficient of variation of transport rate for the whole cross section of the stream bed and that of local points was derived. This information will aid in estimating the accuracy available from the sampling duration used. (Geiger-FRC)
W82-05000

EROSION BY SUBMERGED CIRCULAR JETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 2, p 262-267, February, 1982. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Erosion, *Jets, *Mathematical studies, *Froude number, Scour, *Nozzles, Mathematical equations, Sand, Flow velocity, Plane flow.

Recent work on the erosion of sand beds by plane submerged air and water jets in the impinging as well as wall jet modes shows that, for the air-sand and water-sand systems, even though the functional dependence of the ratios of maximum depth of erosion to impingement height and the diameter of the jet at the nozzle of the densimetric Froude number might be of the same kind, there are considerable differences in the magnitude of these relationships. A series of experiments was performed on the erosion of sand beds by submerged circular impinging water jets to see if this kind of difference exists for circular jets. Similarities were found in the air-sand and the water-sand system, but significant differences concerning the depth, as well as the radial extent of the scour hole were also noted. A relationship involving the densimetric Froude number, the impingement height, and the diameter of the jet at the nozzle influenced the erosion of sand beds by impinging submerged circular water jets, as well as the maximum depth of erosion, the radial extent of the scour hole, and the height of the ridge that forms around the scour hole. For some values of this relationship, the depth of scour in the water-sand system would be smaller while the radial extent of erosion would be much smaller. (Geiger-FRC)
W82-05002

BEND THEORY OF RIVER MEANDERS. PART 1. LINEAR DEVELOPMENT,
Saitama Univ. Urawa (Japan), Dept. of Foundation Engineering.
For primary bibliographic entry see Field 2E.
W82-05085

HYDRAULIC CALCULATIONS OF STABLE UNLINED CANALS BY THE VERTICAL VELOCITY DISTRIBUTION METHOD,
For primary bibliographic entry see Field 8A.
W82-05108

LIBRARY U. OF I., URBANA-CHAMPAIGN

CALCULATION OF LARGE UNLINED CANALS,
For primary bibliographic entry see Field 8B.
W82-05131

DISTRIBUTION OF SUSPENDED SEDIMENT IN THE PATUXENT RIVER, MARYLAND DURING DREDGING OPERATIONS FOR CONSTRUCTION OF A PIPELINE,
Columbia Gas System Service Corp., Wilmington, DE.
E. Onuschak, Jr.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 25-34, 1982. 8 Fig, 6 Ref.

Descriptors: *Dredging, *Sediment transport, *Spoil disposal, Suspended sediment, Turbidity, Patuxent River, Maryland, *Pipelines, Trenches, Erosion, Sediment erosion, Tidal rivers, Estuaries, Environmental effects, *Patuxent River, Maryland.

Dredging in the Patuxent River, Maryland, offered an opportunity to study the environmental impact of temporary, underwater storage of spoil during trench construction in a tidal river. An 8 ft deep trench was dredged with a clam shell-type dredge mounted on a barge. Spoil was deposited in piles underwater within range of the dredge boom. Backfilling from the spoil pile was done after the pipeline had been installed. Suspended solids were measured on the surface, at mid-depth, and at the bottom at 4 sites in the deepest part of the channel before, during, and after dredge operations. During dredging the average turbidity of the water increased a maximum of 2 times (50-70 mg per liter) over the baseline level (30-50 mg/per liter). After dredging was completed, turbidity returned to baseline levels within 3 weeks. Monitoring downstream of the spoil piles indicated that the sediment from the piles was not being significantly eroded. (Cassar-FRC)
W82-05198

ERODIBILITY OF SELECTED SOILS AND ESTIMATES OF SEDIMENT YIELDS IN THE SAN JUAN BASIN, NEW MEXICO,
Geological Survey, Denver, CO. Water Resources Div.
R. M. Summer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195744, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-44, 1981. 33 p, 10 Fig, 9 Tab, 31 Ref.

Descriptors: *Soil erosion, *Small watersheds, Simulated rainfall, *Land reclamation, *Sediment yield, Soil management, Coal mining, *New Mexico, *San Juan basin, Sediment transport.

Onsite rainfall-simulation experiments were conducted to derive field-erodibility indexes for rangeland soils and soils disturbed by mining in coal fields of northwestern New Mexico. Mean indexes on rangeland soils range from 0 grams (of detached soil) on dune soil to 121 grams on wash-transport zones. Mean field-erodibility-index values of soils disturbed by mining range from 16 to 32 grams; they can be extrapolted to nearby coal fields where future mining is expected. Because field-erodibility-index data allow differentiation of erodibilities across a variable landscape, these indexes were used to adjust values of K, the erodibility factor of the Universal Soil Loss Equation. Estimates of soil loss and sediment yield were then calculated for a small basin following mining. (USGS)
W82-05223

SAWMILL BROOK: AN EXAMPLE OF RAPID GEOMORPHIC CHANGE RELATED TO URBANIZATION,
Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
For primary bibliographic entry see Field 4C.
W82-05276

A STOCHASTIC MODEL OF SOIL EROSION,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
T. H. Wu, K. W. Bedford, M. E. Mossaad, K. L. McCurdy, and E. M. Ali.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224734, Price codes: A08 in paper copy, A01 in microfiche. Report No. 711523. 145 p, 55 Fig, 6 Tab, 42 Ref, 4 Append. OWRT A-056-OHIO(1).

Descriptors: *Soil erosion, *Model studies, *Terrain analysis, Surface flow, *Stochastic process, Soil surfaces, Flow, Surface runoff, Surface water, Surface drainage, Mathematical studies, Stochastic hydrology, Probabilistic process, Model testing, Topography, Prediction, Rills, Channels, Rill erosion, Gully erosion, Rainfall intensity, Slope degradation, Runoff, *Erosion rates.

Research was carried out to develop a mathematical model of the progress of erosion on sloping ground that would be able to account for the irregular topography of the ground surface, the overland flow pattern compatible with the topography, and the erosion and topographic change due to flow. The model computes the erosion and flow pattern, and the rill-interrill characteristics as a function of time and space. It also includes simplified mechanisms to simulate ponding, deposition, and failure of side slopes of rills. Sensitivity analysis of the model revealed that the use of shorter time intervals gives better erosion rate estimates. Surface elevation randomness has a significant effect on erosion rate reduction; surfaces with greater random variations evidence smaller erosion rates, while rill pattern randomness appeared to have a smaller effect. The effects of slope gradient, slope length, and rainfall intensity were also examined. The results are in general agreement with experience. (Zielinski-MAXIMA)
W82-05298

A FIELD TECHNIQUE TO DIRECTLY MEASURE RIVER BANK EROSION,
Alberta Research Council, Edmonton.
For primary bibliographic entry see Field 7B.
W82-05410

ON MEASURING TIME-AVERAGED VELOCITIES IN OPEN CHANNEL FLOW,
Copenhagen Univ. (Denmark). Dept. of Geography.
J. Bartholdy.
Sedimentology, Vol 29, No 1, p 91-94, February, 1982. 2 Fig, 7 Ref.

Descriptors: *Open channels, *Flow measurement, Velocity, Channels, Canals, Mathematical studies, Sediment transport, Sedimentation.

The problem of determining the necessary length of time over which velocities must be measured in open channel flows in order to secure accurate time-averaged velocities is addressed. The method presented was tested against the data from velocities measured at 60 second intervals at 10 points in a vertical on the Columbia River below Priest Rapids Dam. The measurements were carried out simultaneously and were continued for 66 minutes. Depth at the measuring station was 6.4 meters, the 66 minute mean velocity was 1.0 meters/second, and the Nikuradse roughness and friction velocities calculated from the velocity profile were 0.31 meters and 0.07 meters/second, respectively. The experiments and theory applied to determine the necessary equations were based on a steady and uniform two-dimensional flow. The results are therefore limited to cases in which these conditions are fulfilled or can be approximated. Where inhomogeneities in the water column play an important role, such as in stratified estuaries, or where discontinuities in the cross-profile cause large eddies to appear, the measuring time must necessarily be much longer than predicted herein. In spite of these limitations, the method as described can find use in many natural channels and offers the possibility of making a qualified choice of the optimal measuring time when working in the field. (Baker-FRC)
W82-05462

SOURCES OF SEDIMENT-INDUCED REDUCTIONS IN WATER QUALITY APPRAISED FROM CATCHMENT ATTRIBUTES AND LAND USE,
H. W. Anderson.
Journal of Hydrology, Vol 51, No 1-4, p 347-358, May, 1981. 7 Tab, 9 Ref.

Descriptors: *Suspended sediments, *Sediment load, Catchment areas, Land use, Water quality, Sediment discharge, Factor analysis, Mathematical studies, Streamflow, Landslides, Geology.

In order to develop estimates of sediment discharge from catchments or of the expected contribution of parts of catchments to sediment discharge or to sediment-induced reductions in water quality, it is first necessary to evaluate the sources and causes of suspended sediments. Suspended sediment measurements from 61 catchments in California were used to relate suspended sediment discharge to the following ten catchment attributes: steep grasslands, landslide potential, watershed steepness, rain-snow frequency, streamflow volume, poor logging, watershed shape, unconsolidated sediment, geology (including faults), and forest fires. Suspended sediment was normalized by using long-term streamflow estimates for each catchment. Factor analysis showed no confounding among the ten variables. The ten variable regressions had an explained variance of 73%. The contribution of watershed factors to this explained variance in suspended sediment discharge was as follows: landslide potential, 31%; steep grasslands, 11%; streamflow and rain-snow frequency, 12%; poor logging, 9% and other, 10%. Catchment shape was the least important variable, while differences in landslide classes produced the greatest differences in sediment discharge. A separate analysis was used to develop a basis for calculating landslide classes from catchment attributes. The results of these analyses were applied to the Redwood Creek Basin in California to separate natural from accellrated sediment discharge and sediment concentration in the basin. It was concluded that thee relationships found in this study have direct application to thee evaluation of sedimentation problems and control in northern California and control in northern California and may give some first approximation to evaluations in other areas. (Carroll-FRC)
W82-05494

SEDIMENTARY RECORD OF RAINFALL VARIATIONS ON A SUB-HUMIC LAKE,
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey.
Nature (London), Vol 296, No 5856, p 434-436, April 1, 1982. 4 Fig, 26 Ref.

Descriptors: *Lake sediments, *Sedimentology, *Climatology, Dayat Afougach, Morocco, Precipitation, Prediction, Rainfall, Sedimentation rate.

A 1.3 m sediment core was obtained from the deepest part of a lake, Dayat Afougach, Morocco, on September 25, 1979. Fourier analysis was performed on the dry weights of 1 or 2 cm sections and the annual rainfall totals from 1958-79 for Ifrane, 23 km from the lake. At a wave length of about 12 cm (range 8-18 cm) an annual sedimentation cycle was evident. This was consistent with previous evidence that in this Mediterranean-type climate sediment particle size is largest (highest dry weight) in the wet season immediately following the dry season. The relationships of organic matter, Na, Mg, and Fe to dry weight show that particle size is responsible for the variations in dry weight. The 12 cm annual sedimentation rate is also consistent with data from other lakes in similar environmental settings. Lower sediment dry weights were found at core depths corresponding to 1971-74, low rainfall years. Study of lake sediment dry weights may give information on precipitation patterns in areas where climatological records are not available. (Cassar-FRC)
W82-05516

HINDERED BEDLOAD SETTLING AS A MODEL OF SAND BED PLANATION BY WATER WAVES,

Coastal Engineering Research Center, Fort Belvoir, VA.
R. J. Hallermeier.
Nature, Vol 297, No 5861, p 53-55, May 6, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Sediment transport, *Bed load, *Wave action, Planation, Sand, Fluid flow, Flow velocity, Oscillatory waves, Settling velocity, River beds.

Sand bed planation is converted to a threshold effect in hindered settling with increasing concentration of noncohesive sediment moving near the bed. The equation derived was consistent with laboratory results using 15 sediments with buoyance indexes of 19 to 137,000, corresponding to quartz sand in water. The viewpoint in this paper is different from that of Bagnold's criterion for planar bed occurrence for unidirectional and oscillatory flows. (Cassar-FRC)
W82-05607

DETERMINATION OF RECENT DESPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS,
Heidelberg Univ. (Germany, F. R.). Lab. for Sedimentology.
For primary bibliographic entry see Field 5B.
W82-05625

EROSION FROM MOUNTAIN SNOWPACK MELT,
Utah State Univ., Logan. Watershed Science Unit.
G. E. Hart, and S. A. Loomis.
Journal of Soil and Water Conservation, Vol 37, No 1, p 55-57, January/February, 1982. 1 Tab, 3 Ref.

Descriptors: *Snowmelt, *Erosion, *Surface runoff, Snowpack, Mountains, Soil erosion, *Utah, Slopes, Runoff, Infiltration.

Soil loss from clear-weather snowmelt was minimal on four test plots located on a bare mountain slope in Utah. Erosion was 2.8-10.6 pounds per acre on the plots with 11% slope and 7.8-23.6 pounds per acre on the plots with 32% slope. Maximum snowpack in 1978 was 12 inches water equivalent; in 1979, 16 inches; and in 1980, not measured. Soil loss was twice as great in 1979 as in 1978, although the snowmelt runoff volume in 1979 was three times greater. Most of the snowmelt infiltrated into the soil. Only a small percentage of the water equivalent in the snowpack appeared as surface runoff, up to 1.3% on the gentle slope and 1.0-3.5% on the steep slope. The small soil losses do not warrant inclusion of the snowmelt factor in the universal soil loss equation in mountain terrain with a moderately deep snowpack which persists throughout the winter. (Cassar-FRC)
W82-05664

BEDLOAD AND SIZE DISTRIBUTION IN PAVED GRAVEL-BED STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, P. C. Klingeman, and D. G. McLean.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 544-571, April, 1982. 14 Fig, 5 Tab, 20 Ref.

Descriptors: *Bed load, *Gravel, Streams, Sediment transport, Sediment load, Mathematical equations, Model studies, *Oregon, Oak Creek.

An attempt has been made to describe, based solely on field data, bedload relations for natural, paved gravel-bed streams. Data gathered from Oak Creek, Oregon were used to study the size distribution of bedload in paved gravel-bed streams. Similarity analysis suggests that once the pavement is broken, essentially all sizes are rendered of roughly equal mobility. This implies that for poorly-graded gravels only one grain size is required to characterize total bedload as a function of Shields stress, and that not much extra accuracy can be gained by calculating the bedload for each size range separately and summing. It also suggests that the bedload size distribution should approximate that of the pavement. The first implication was used to develop a simple means of predicting total bedload in gravel bed streams in conjunction with data from Oak Creek, the Elbow River, and other streams. The method approximates accuracy for streams with moderate to steep slopes that are not dominated by sand throughput load. The second implication would appear to apply in terms of annual sediment yield form gravel-bed streams that are not dominated by throughput load. A reanalysis of the Oak Creek data reveals that higher flows favor coarser bedload material. As concerns the relation of Meyer-Peter and Muller, its performance regarding the field data presented in this study is poor. There also appears to be no way to adjust the relation in terms of an effective grain size to bring it into accord with the data. Thus, it is not recommended. (Baker-FRC)
W82-05795

TRAP EFFICIENCY STUDY, HIGHLAND CREEK FLOOD RETARDING RESERVOIR NEAR KELSEYVILLE, CALIFORNIA, WATER YEARS 1966-77,
Geological Survey, Menlo Park, CA. Water Resources Div.
L. F. Trujillo.
Geological Survey Water-Supply Paper 2182, 1982. 15 p, 7 Fig, 8 Tab, 12 Ref.

Descriptors: *Trap efficiency, *Detention reservoirs, *Sediments, *California, Water storage, Sediment transport, Particle size, Chemical analysis, *California, Lake County, Kelseyville, Highland Creek Reservoir.

This investigation is part of a nationwide study of trap efficiency of detention reservioirs. In this report, trap efficiency was computed from reservoir inflow and outflow sediment data and from reservoir survey and outflow data. Highland Creek Reservoir is a flood retarding reservoir located in Lake County, near Kelseyville, California. This reservoir has a maximum storage capacity of 3,199 acre-feet and permanent pool storage of 921 acre-feet. Mean annual rainfall for the 14.1-square-mile drainage area above Highland Creek Dam was 29 inches during the December 1965 to September 1977 study period. Resultant mean annual runoff was 17,100 acre-feet. Total reservoir inflow for the 11.8-year study period was 202,000 acre-feet, transporting an estimated 126,000 tons (10,700 tons per year) of suspended sediment. Total reservoir outflow for the same period was 188,700 acre-feet, including 15,230 tons (1,290 tons per year) of sediment. Estimated trap efficiency for the study period was 88 percent, based on estimated sediment inflow and measured sediment outflow. Reservoir surveys made in December 1965 and April 1972 revealed a storage capacity loss of 35.8 acre-feet during the 6.3-year period. Ccomputed by using an estimated specific weight, this loss represents 54,600 tons of deposited sediment. Sediment outflow during the same period was 8,890 tons. Trap efficiency for the survey period was 86 percent. (USGS)
W82-05852

POTENTIAL SEDIMENT PRODUCTION WITHIN VEGETATIVE COMMUNITIES IN OREGON'S BLUE MOUNTAINS,
Oregon State Univ., Corvallis. Dept. of Rangeland Resources.
J. C. Buckhouse, and R. E. Gaither.
Journal of Soil and Water Conservation, Vol 37, No 2, p 120-122, March/April, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Sediment yield, *Erosion rates, *Vegetation effects, *Forest hydrology, Sagebrush, Grasslands, Meadows, Alpine regions, Pine trees, Fir trees, Juniper trees, Sspruce trees, Trees, Larch trees, Blue Mountains, Oregon, Infiltrometers, Soil erosion.

Potential sediment losses were determined in 10 natural ecosystems in Oregon's Blue Mountains using a Rocky Mountain infiltrometer simulating rainstorms of 10 cm per hour. Potential sediment production levels (kg per ha) in various ecosystems were: juniper, 1572; sagebrush, 1284; grassland, 431; spruce-fir, 217; ponderosa pine, 183; alpine, 140; Douglas fir, 109; lodgepole pine, 36; meadow, 22; and larch, 15. As ecological condition class and/or vegetative productivity class changed within an ecosystem, significant changes in potential sediment production occurred. Condition class refers to tree size in forested units and to condition (poor to fair) in other ecosystems. Productivity refers to pounds per acre of forage or cu ft per acre per year of wood produced, Class I being most productive and Class IV, least productive. In general, sediment losses increased as the condition class changed from good toward poor and decreased with improvement in productivity. (Cassar-FRC)
W82-05867

SEDIMENT MIXING AND ACCUMULATION RATE EFFECTS ON RADIONUCLIDE DEPTH PROFILES IN HUDSON ESTUARY SEDIMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
C. R. Olsen, H. J. Simpson, T.-H. Peng, R. F. Bopp, and R. M. Trier.
Journal of Geophysical Research, Vol 86, No C11, p 11020-11028, November 20, 1981. 10 Fig, 31 Ref.

Descriptors: *Sediment distribution, *Estuarine environment, Estuaries, Sediments, Sedimentation, Hudson River, Rivers, Radioactivity.

A comparison was made of the measured anthropogenic radionuclide profiles in sediment cores from the Hudson River estuary by using known input histories of radionuclides to the estuary and mixing coefficients which decreased exponentially with depth in the sediment. The effective mechanical mixing rates of the upper layers of sediments appeared to be of the order of 0.25 to 1 square centimeter per year or less. These rates do not appear to alter substantially the depth of subsurface activity peaks owing to reactor releases in areas with accumulation rates of 1 cm per year or greater. Thus the subsurface peak radionuclide activities in Hudson sediments appear to be useful as first order time stratigraphic reference levels for estimating rates and patterns of sediment accumulation. Variations in the observed sediment radionuclide depth profiles from trends that would be expected from the history of fallout delivery and reactor releases can be used as indicators of the various processes regulating particle transport and accumulation along the axis of the Hudson estuary. (Baker-FRC)
W82-05868

2K. Chemical Processes

CHEMICAL FRACTIONATION OF HEAVY METALS IN WASTEWATER-AFFECTED SOILS,
Chile Univ., Santiago. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-04781

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: PART 2, THEORETICAL CONSIDERATIONS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 8G.
W82-04791

APPLICATION OF AN APPROXIMATE ANALYTIC METHOD OF COMPUTING SOLUTE PROFILES WITH DISPERSION IN SOILS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-04876

A CONTRIBUTION TO SIMPLIFIED MODELS OF FIELD SOLUTE TRANSPORT,

LIBRARY U. OF I.- URBANA-CHAMPAIGN

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-04877

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: I. SUNLIGHT INDUCED REACTIONS OF AQUATIC POLLUTANTS PHOTOSENSITIZED,
Environmental Research Lab., Athens, GA.
R. G. Zepp, G. L. Baughman, and P. F. Schlotzhauer.
Chemosphere, Vol 10, No 1, p 109-117, January, 1981. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Humic acids, *Organic compounds, *Chemical reactions, *Photochemical reactions, Fulvic acids, Organic matter, Disulfoton, Aniline, Pentadiene, Dimethylfuran, Kinetics, Fate of pollutants, Solar radiation, Oxygenation, Comparison studies.

Organic chemicals which do not undergo photochemical reactions in distilled water degraded when exposed to sunlight in water containing natural or commercial humic substances. Chemicals tested were disulfoton, aniline, 2,5-dimethylfuran, and cis-1,3-pentadiene. Photoproducts were generally the same for each chemical regardless of the source of humic material. Kinetic data indicated that rate constants were within a factor of 2 in solutions of humic substances of different origin. Disulfoton and 2,5-dimethylfuran underwent photosensitized oxygenation to disulfoton sulfoxide and diacetylethylene, respectively. The half life of disulfoton ranged from 4 hours during summer to 10 hours during winter. The major photoproduct of aniline was azobenzene; the half life of aniline in May was 4-8 hours. Cis-1,3-pentadiene isomerized to trans-1,3-pentadiene. (Cassar-FRC)
W82-04914

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: II. PHOTOSENSITIZED OXYGENATIONS,
Environmental Research Lab., Athens, GA.
R. G. Zepp, G. L. Baughman, and P. F. Schlotzhauer.
Chemosphere, Vol 10, No 1, p 119-126, January, 1981. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Humic acids, *Chemical reactions, *Organic compounds, Fate of pollutants, Dimethylfuran, Organic matter, *Photochemical reactions, Kinetics, Solar radiation, Oxygenation, Comparison studies.

The photochemical oxygenation of 2,5-dimethylfuran (DMF) in water was investigated using humic substances from natural sources and commercial sources as photosensitizers. At low DMF concentrations the reactions were first order with respect to DMF. Reaction rate constants were directly proportional to the average light intensity and to the concentration of humic substances. Rate constants were independent of hydrogen ion activity from pH 5 to 10. Above pH 10 the rate constants decreased with increasing pH. Ultraviolet and blue radiation were most influential in the photosensitization. Rate constants for this reaction calculated from computer-simulated sunlight intensities agreed well with the observed values. Since the ratios of sunlight rate constants to total visible solar irradiance (400-700 nm) were nearly constant, it may be possible to calibrate the rate constants in terms of units such as foot candles. (Cassar-FRC)
W82-04915

THE OCCURRENCE AND ORIGIN OF METHANE IN SOME GROUNDWATER FLOW SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, and P. Fritz.
Canadian Journal of Earth Sciences, Vol 18, No 12, p 1802-1816, December, 1981. 5 Fig, 4 Tab, 62 Ref.

Descriptors: *Methane, *Carbon isotopes, *Geochemistry, *Groundwater, Organic matter, Landfills, Sanitary landfills, Chemical reactions, Biodegradation.

Groundwaters from 10 areas in Canada and the U.S. contained methane at levels from below the detection limit of 10 to the minus 7th power mol per liter to 0.0063 mol per liter. The origin of the methane was determined from carbon isotope ratios. Of 28 samples whose stable carbon isotope ratios were measured, 5 samples with delta C13 values greater than -45 o/oo were of thermocatalytic origin (nonbiological, chemical production). The common biogenic methanes had delta C13 values less than -60 o/oo. Biogenic methanes from sanitary landfill sites had intermediate values of -38 to 56 o/oo and were easily distinguished from normal biogenic methanes. The biogenic methanes in this study appeared to derive from organic matter. The carbon isotope ratios of dissolved methane and total inorganic carbon were not controlled by equilibrium fractionation processes but by kinetic isotope effects. (Cassar-FRC)
W82-04925

NITROGEN AND PHOSPHORUS DYNAMICS IN HOT DESERT STREAMS OF SOUTHWESTERN U.S.A.,
Arizona State Univ., Tempe. Dept. of Zoology.
N. G. Grimm, S. G. Fisher, and W. L. Minckley.
Hydrobiologia, Vol 83, No 2, p 303-312, 1981. 5 Fig, 2 Tab, 46 Ref.

Descriptors: *Streams, *Deserts, Arid lands, *Nitrogen, *Phosphorus, Chemical properties, Nutrients, *Arizona, Nitrates, Phosphates, *Gila River basin.

The potentials for nutrient limitation in streams in hot, arid and semi-arid regions of Arizona were examined by determining the dynamics of nitrogen and phosphorus in 38 different systems of the Gila River drainage. Thirty-eight low elevation streams and stream segments were sampled in Southern Arizona, primarily in summer 1979. Most sites were in the Sonoran Desert, with some in a transition zone between the Sonoran and Chihuahuan Deserts and others in Interior Chaparral. Perennial flowing waters in the Sonoran Desert region usually exist because they originate in highlands outside arid zones. Typical Arizona surface waters are carbonate dominated. Highest nitrogen concentrations were associated with stream sources and flood waters which enter stream channels at elevated nitrogen levels after recent contact with nitrate rich terrestrial soils. Soluble reactive phosphate was not significantly higher in sources and floods than in free-flowing streams, and in the latter, concentrations were usually greater than 0.5 microM. Nitrogen is a likely candidate for nutrient limitation in free flowing streams of this region. Nitrate, but not soluble reactive phosphate, was correlated with periphyton abundance and net production in reaches originating at enriched sources. Rapid uptake by periphyton lowered nitrate concentrations to potentially limiting levels; however, soluble reactive phosphate was seldom depleted and was apparently controlled by other factors. Thus, in spite of the presence of nitrate enriched sources in desert streams, nitrogen may be reduced to limiting levels before phosphorus. (Baker-FRC)
W82-04930

THE EFFECT OF PRESSURE ON THE SOLUBILITY OF MINERALS IN WATER AND SEAWATER,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 1B.
W82-05135

METAL ION COMPLEX FORMATION CONSTANTS OF SOME SEDIMENTARY HUMIC ACIDS WITH ZN(II), CU(II) AND CD(II),
Lehigh Univ., Bethlehem, PA. Dept. of Chemistry.
M. L. Sohn, and M. C. Hughes.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2393-2399, December, 1981. 1 Fig, 3 Tab, 52 Ref.

Descriptors: *Humic acids, *Bottom sediments, *Metal complexes, Zinc, Copper, Cadmium, *Lake sediments, *Marine sediments, Chemical analysis.

Humic acids form one of the most important source/sink systems for metal ions in the soils and bottom sediments in both fresh and saline waters. A substantial portion of the metal ions presented in soils and sediments is bound in labile form to humic acids. A size exclusion chromatography technique as used to determine metal ion complex formation constants for several sedimentary humic acids derived from a fresh water lake and several coastal marine environments. Zinc(II), copper(II), and cadmium(II) were selected are representative of pollutant metals in coastal areas. Only one type of binding site was observed in all cases. Elemental composition of the sedimentary humic acids, except that the nitrogen content was sifnificantly higher in the sedimentary humic acids. Other chemical properties of the sedimentary humic acids were consistent with previously reported findings. Spectroscopic measurements indicated that the sedimentary humic acids may have contained significant amounts of polysaccharide compunds which were not removed by conventional separation and purification processes, but analysis showed only very low levels of polysaccharides present in the humic acids. (Carroll-FRC)
W82-05136

THE EFFECTS OF ADSORBED HUMIC SUBSTANCES ON THE SURFACE CHARGE OF GOETHITE (ALPHA-FE00H) IN FRESHWATERS,
Freshwater Biological Association, Cumbria (England).
E. Tipping, and D. Cooke.
Geochimica et Cosmochimica Acta, Vol 46, No 1, p 75-80, January, 1982. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Organic matter, *Electrical properties, *Iron oxides, Surface water, Ions, Cations, Calcium, Magnesium, *Electrophoresis, Adsorption, Shear, *Chemical reactions.

Electrophoresis has been used to demonstrate that a negative charge is conferred on a variety of types of particles in freshwaters by the adsorption of organic matter. A previous study of a single lake showed that the magnitude of the negative charge conferred on the surface by adsorbed humic substances was determined not only bu the amount of humics adsorbed, but also by coadsorbed bivalent calcium (Ca) and magnesium (Mg) ions. This study attempted to generalize these earlier results by measuring electrophoretic mobilities of a model iron oxide, goethite, added to solutions in which humic and cation concentrations were varied systematically over wide ranges, to surface water samples from three more British lakes having varied chemical properties, and to artificial lakewaters with compositions based on those of the natural samples. These electrophoretic measurements showed that goethite particles added to lake surface water samples become negatively charged because of the adsorption of humic substances. The magnitude of the negative charge was found to decrease with increasing concentrations of the bivalent cations Ca(2 plus) and Mg(2 plus). It is suggested that the large molecular size of the humics causes the plane of electrokinetic shear to be some distance from the oxide surface, with the shear potential attributable to ionized humic functional groups not involved in adsorptive interactions with the oxide surface. This model accounts qualitatively for (a) the effects of Ca(2 plus) and Mg(2 plus) in terms of interactions with the humic functional groups in the shear plane; (b) the pH-dependence of the electrophoretic mobilities; and (c) the lack of effect of inorganic phosphate and silicate on the mobilities, despite the shared ability of these solutes to compete with humics for adsorption at natural concentrations. (Carroll-FRC)
W82-05140

HUMIC SUBSTANCES,
For primary bibliographic entry see Field 5B.
W82-05148

PLANKTON METABOLISM AND CARBON PROCESSES IN THE AMAZON RIVER, ITS TRIBUTARIES, AND FLOODPLAIN WATERS, PERU-BRAZIL, MAY-JUNE 1977,
Washington Univ., Seattle. Coll. of Fisheries.
R. C. Wissmar, J. E. Richey, R. F. Stallard, and J. M. Edmond.
Ecology, Vol 62, No 6, p 1622-1633, December, 1981. 6 Fig, 1 Tab, 77 Ref.

Descriptors: *Plankton, *Carbon cycle, Ecosystems, Aquatic environment, *Nutrients, Cycling nutrients, Flooding, Phytoplankton, Suspended solids, Bacteria, South America, Brazil, Peru, *Amazon River.

The biological and chemical characteristics of the various plankton environments of the Amazon River system were examined in an effort evaluate the influence of exogenous carbon and nutrients on plankton metabolism and the importance of respiration and phytoplankton production to the carbon dioxide equilibria in the riverine and floodplain waters. The study results indicated that large-scale events such as flooding can have a major impact upon the cycling of carbon and nutrients in these aquatic ecosystems. The major factors influencing primary production during high water appeared to be nutrient concentrations in the mouthbays and varzea (floodplain) lakes and high levels of suspended matter in the Amazon mainstream. Bacterial densities, carbon-14-acetate uptake rate constants, and plankton carbon: ATP ratios implied that heterotrophic microbiota were important components of the plankton communities in riverine waters. High particulate carbon: nitrogen ratios (20:1) indicated that terrestrial organics were important to metabolic activity in all Amazon surface waters. The observed supersaturation of Amazon waters by carbon dioxide was similar to observations for other rivers of the world. The primary source of the carbon dioxide is most likely decomposing organic matter in planktonic and benthic environments of the rivers, lakes, and flooded terrestrial lowlands. These findings support the hypothesis that respiratory input of carbon dioxide balanced by evasion is sufficient to explain high carbon dioxide vapor pressures in the Amazon, but further examination is recommended. (Carroll-FRC)
W82-05197

QUALITY OF GROUND WATER IN ROUTT COUNTY, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-05227

CHEMICAL CHARACTER OF WATER IN THE RED RIVER ALLUVIAL AQUIFER, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05228

THEORETICAL ANALYSIS OF IONIC EQUILIBRIA IN NATURAL WATER,
Moscow State Univ. (USSR).
V. S. Savenko.
Water Resources, Vol 8, No 2, p 173-185, March-April, 1981. 9 Tab, 59 Ref. Translated from Vodnye Resursy, No 2, p 120-133, March-April, 1981.

Descriptors: *Ions, *Activity coefficient, *Equilibrium, *Chemical reactions, Seawater, Geochemistry, Thermodynamics, *Saline water, Sodium, Potassium, Calcium, Magnesium, Sulfates, Fluorides, Chlorides, Bromides, Iodides, Bicarbonates, Carbonates, Sulfides, Theoretical analysis.

Experimental data on activity coefficients of ions and salts in seawater were compared with theoretical predictions obtained from several methods. Differences between experimental and theoretical activity coefficients of ions and salts did not exceed 0.03-0.05 (5-10% relative) and were within the limits of accuracy in determining the instability of ion pairs. The greatest differences were seen for strongly associated salts. Therefore, chemical reactions should be calculated with respect to the least associated salts. (Cassar-FRC)
W82-05239

SULFATE BUDGET AND MODEL FOR SULFATE CONCENTRATIONS IN STREAM WATER AT BIRKENES, A SMALL FORESTED CATCHMENT IN SOUTHERNMOST NORWAY,
Central Insitute for Industrial Research, Oslo (Norway).
N. Christophersen, and R. F. Wright.
Water Resources Research, Vol 17, No 2, p 377-389, April, 1981. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Sulfates, *Streams, *Forest watersheds, Watersheds, Forest soils, Soil types, Catchment areas, Catchment basins, River basins, Chemical composition, Solute transport, Birkenes catchment, *Norway.

The flux of sulfate into and out of the Birkenes catchment is calculated from data collected over a 6 yr period. Ground vegetation is 58% blueberry-bracken community, 28% pine community, and 7% fen and bog forest. Soils consist of 79% podzols, 17% peaty soils and 4% bare rock. Bedrock is biotite-granite. The annual sulfate flux is about 5-10 times higher than would be expected. The result is an acidification of stream water and an increased leaching of base cations from the soil. The concentration of sulfate in stream water at Birkenes shows a characteristic pattern of high levels in the first stormflow following a dry summer period and low levels in baseflow. Sulfate is assumed to accumulate in the uppermost soil layers due to dry deposition and evapotranspiration of rainwater. Mineralization of other sulfur compounds is included indirectly. In the lower mineral soil layers, adsorption/desorption of sulfate is assumed to occur. The ability of this simple model to simulate sulfate concentrations in stream water suggests that the model quantitatively accounts for these processes. (Baker-FRC)
W82-05288

ION HYDRATION AND ION INTERACTION,
Maryland Univ., College Park. Dept. of Chemistry.
G. Atkinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224841, Price codes: A02 in paper copy, A01 in microfiche. Report, October 1981. 21 p, 2 Tab, 11 Ref. OWRT (No 1656)(1), 14-01-0001-1656(1).

Descriptors: *Ion transport, *Thermodynamics, *Salts, *Equilibrium, *Chemical reactions, *Hydration, Ionic interference, Anions, Cations, Ions, Salinity, Seawater, Ultrasonics, Baseline studies, Chemical analysis, Water properties, Research needs.

A summary is provided on research which was undertaken to define the nature and properties of aqueous ionic species and to understand the relationship between individual ion hydration and classical thermodynamic properties. The research, experimentally, relied heavily on relaxation methods (particularly, ultrasonic absorption (UA) to bridge the gap between dynamic processes and equilibrium considerations. Studies with UA were made on aqueous solutions of tetraalkylammonium halide salts as a function of concentration and temperature. Combining the UA results with dielectric relaxation and equilibrium thermodynamics made it possible to quantitatively describe such systems in terms of the coupled equilibrium processes. Partial molal volumes and compressibilities at infinite dilution are directly related to the structural effects of the salts in water. Measurements of sound velocity in salt solutions down to 0.0001 molal were made for developing ionic compressibility data. In addition, several aqueous salt equilibria were studied and a lanthanide nitrate complexation model was quantitatively treated. Application in this case was directed towards the interaction between multivalent cations and various anions which lead to many important association equilibria in sea water. (Zielinski-MAXIMA)
W82-05310

EXCHANGE OF MARINE SODIUM FOR CALCIUM DURING CHEMICAL WEATHERING IN THE ISLE AUX MORTS RIVER BASIN, NEWFOUNDLAND,
Canada Center for Inland Waters, Burlington (Ontario).
M. E. Thompson.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 361-365, March, 1982. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Weathering, *Salts, *Ion exchange, Precipitation, Sea salt, Sodium, Calcium, *Isle aux Morts, *Newfoundland, Rivers, Chlorides, Sodium chloride, Chemical composition, Cation exchange.

Sea salt corrections must be applied in coastal river water chemistry studies prior to calculating weathering rates and evaluating the impact of acid precipitation. Sea salt corrections applied to data on contents of major seawater ions (Ca, Mg, Na, K, chloride, sulfate and bicarbonate) in the Isle aux Morts River, Newfoundland, using Cl(-) as the indicator species produced several negative values of Na(+). These were most numerous in winter when sea salt concentrations were high. Periods of negative Na(+) corresponded with periods of higher than usual Ca(2+) concentrations, suggesting that the higher sea salt levels may promote an exchange reaction in the soils: calcium silicate + 2Na(+) = sodium silicate + Ca(2+). Analysis of atmospheric precipitation in this region showed that sea salt levels were highest in winter and early spring. (Cassar-FRC)
W82-05414

SULFUR SPECIATION AND ASSOCIATED TRACE METALS (FE, CU) IN THE PORE WATERS OF GREAT MARSH, DELAWARE,
Paris Univ. (France). Lab. of the Geochemistry of Water.
J. Boulegue, C. J. Lord, III, and T. M. Church.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 453-464, March, 1982. 5 Fig, 3 Tab, 63 Ref.

Descriptors: *Sulfur compounds, *Metals, *Chemical reduction, Sediments, Tidal marshes, *Salt marshes, Marshes, *Great Marsh, *Delaware, Estuarine environment, Trace elements, Copper, Iron, Oxidation-reduction potential, Pore water, Sulfides, Hydrogen sulfide, Polysulfides, Thiosulfates, Sulfates, Sulfites, Organic matter, Decomposition.

Sulfur species and trace metals were determined in pore waters of sediments from a salt marsh near Lewes, Delaware. Three cores were collected during the summer of 1978, one to study the analytical methods, one a day before the monthly inundation and one at the end of the inundation period. The most important of the many inorganic and organic sulfur compounds detected at significant levels were hydrogen sulfide, polysulfides, and thiosulfates. Equilibria between hydrogen sulfide, thiols, and the polysulfides depend on the redox conditions. Bacterial sulfate reduction is dominant in the pore waters except at the surface during dry conditions, where oxidation of hydrogen sulfide produces thiosulfate and sulfide. Inorganic polysulfides are formed from the reaction of hydrogen sulfide with elemental sulfur. Organic polysulfides are the result of the reaction of thiols with elemental S and/or organic polysulfides. Thiols are produced by reactions of organic matter with hydrogen sulfide and/or elemental S. Thiosulfates are yielded by hydrogen sulfide oxidation and the hydrolysis of polysulfides and pyrite. It is suggested that the redox couple sulfide/polysulfide is a good indicator in this situation. Concentrations of Cu and Fe in the pore waters are controlled by formation of metal sulfides. Cu is probably complexed by organic matter, possibly a thiol. (Cassar-FRC)
W82-05415

THE CHEMISTRY OF SUSPENDED MATTER IN ESTHWAITE WATER, A BIOLOGICALLY

LIBRARY U. OF I., URBANA-CHAMPAIGN

PRODUCTION LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,
Edinburgh Univ. (Scotland). Dept. of Geology.
E. R. Sholkovitz, and D. Copland.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 393-410, March, 1982. 23 Fig, 6 Tab, 49 Ref.

Descriptors: *Particulate matter, *Seasonal variation, *Chemical precipitation, Sampling, *Esthwaite Water, *United Kingdom, Suspended solids, Anaerobic conditions, *Lakes, Organic carbon, Iron, Manganese, Phosphorus, Sulfur, Magnesium, Potassium, Barium, Calcium, Phytoplankton, Hypolimnion, Oxidation-reduction potential, Chemical reduction, Geochemistry, Adsorption, Iron oxide.

A study of ten water column profiles in Esthwaite Water (England's Lake District) between April and November 1979 revealed that particle chemistry in this highly productive lake is controlled by three biogeochemical cycles. A large excess of particulate P, S, Mg, Ca, Ba, and K is generated in situ in the epilimnion by growth of phytoplankton in spring and summer. Concentration variations follow that of particulate organic carbon. This particulate buildup is a result of oxidative precipitation of ferric oxide, which causes adsorption and/or coprecipitation with the Mg, Ca, and other elements. The formation of ferric oxide is, in turn, a result of the dissolved ferrous iron released as the hypolimnion becomes anoxic. The onset of anoxic conditions in the hypolimnion also induces an increase in bacterial populations in the bottom water. As reducing conditions become more intense after July, the iron oxide particles with the associated particulate Mg, Ca, etc., solubilize. Just before the lake overturns, large populations of bacteria and the formation of FeS particles control the concentration of excess particulate carbon, S, P, Mg, K, and Ca. The results of this study point out the importance of understanding the biogeochemical cycles in designing sampling schedules for monitoring a lake's natural or man-modified chemistry. (Cassar-FRC)
W82-05416

FLUORAPATITE AND FLUORITE SOLUBILITY CONTROLS ON GEOTHERMAL WATERS IN YELLOWSTONE NATIONAL PARK,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 465-474, March, 1982. 4 Tab, 42 Ref.

Descriptors: *Phosphates, *Solubility, *Geothermal studies, Fluorapatite, *Chemical composition, *Yellowstone National Park, Wyoming, Equilibrium, Hot springs, Chlorides, Fluorite, Calcium fluoride, Geochemistry, Saturation, Geysers.

Stauffer and Thompson's (1978) data on the phosphate contents of six differing classes of Yellowstone National Park geothermal waters were analyzed by a computer program, WATEQF. The near-boiling high-chloride waters (Class I) were at or near saturation with respect to fluorapatite. The 16 springs in this category had fluorapatite saturation indexes ranging from -3.2 to +4.9 (average +0.9). The strongly positive indexes were associated with the high alkaline conditions resulting from adiabatic cooling near the surface. Spring waters diluted with meteoric water (Class II) had lower chloride content, lower pH, and were undersaturated with fluorapatite in spite of high phosphate and Ca concentration. The travertine-depositing mixed water springs (Class VI) were super-saturated with fluorapatite at the surface and at or near saturation with hydroxylapatite. The supersaturation may be a result of kinetic inhibition of apatite crystallization by the high concentrations of Mg(++) and bicarbonate as well as the lower water temperatures. With respect to fluorapatite, Class III waters (hot, near neutral condensed vapor springs) were also weakly supersaturated, Class IV waters (acid Norris mixed water springs) were strongly undersaturated, and Class V waters (bicarbonate buffered mixed water springs) were weakly undersaturated. The hottest spring waters (90-100 C at the surface) were undersaturated with calcium fluoride at the surface, probably as a result of fluorite equilibration at the higher temperatures (> 200 C) in deeper reservoirs. (Cassar-FRC)
W82-05449

RADIUM CONTENT AND THE 226RA/228RA ACTIVITY RATIO IN GROUNDWATER FROM BEDROCK,
Institute of Radiation Protection, Helsinki (Finland).
M. Asikainen.
Geochimica et Cosmochimica Acta, Vol 45, No 8, p 1375-1381, August, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Radioactivity, *Groundwater, *Bedrock, *Aquifers, *Radium, Geologic formations, Chemical composition, Radium radioisotopes, Isotope fractionation, *Finland, Wells, Leaching, Groundwater dating.

The concentrations of Ra228 and the Ra226/Ra228 ratio in water from drilled wells situated in different parts of Finland were investigated. Areas with unusually highly radioactive water were emphasized in this study, and Ra228 was analyzed mainly in samples with an elevated Ra226 content. These measurements were supplemented by additional analyses of Ra226 and Ra228 carried out on water from some drilled wells situated in areas with no known radioactivity anomalies in groundwater. The concentration of Ra228 was independent of the amount of Ra226 present in the samples. The concentrations of Ra228 were nearly the same over the whole range of Ra226 concentrations, and the average Ra226/Ra228 ratio increased sharply as the Ra226 content of water increased. The Ra226/Ra228 ratio in the drilled wells varied from 0.3 to 26. Abnormally high Ra226/Ra228 ratios were found in areas with known uranium deposits as well as in several drilled wells at other locations. The abnormally high Ra226/Ra228 ratios present in groundwater suggest that the radioactivity anomaly is caused by uranium deposits and not by common rocks. In samples with a low radioactivity level, the average Ra226/Ra228 ratio was slightly below unity, corresponding to the typical U/Th ratio of granite, the most common kind of rock in the study area. The samples from the rapakivi area proved to be exceptional in that they had a low Ra226/Ra228 ratio, independent of the concentration of Ra226. (Baker-FRC)
W82-05450

FORMS OF THE MIGRATION OF METALLIC IONS IN FRESH WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Hydrobiological Journal, Vol 17, No 1, p 91-92, 1981.

Descriptors: *Ion transport, *Rivers, Manganese, *Dnieper River, Hydrobiology, *Heavy metals, Kinetics, Aquatic life, Chemical composition, Path of pollutants, Pollutant identification, *USSR.

An outline for step by step analysis of surface waters for the content of individual forms of metals has been developed. This outline may be used to determine the following, most general characteristics of the state of metallic ions in fresh water: the distribution of the metal between suspended, colloidal and truly dissolved forms; the concentration of free metallic ions and ions in complexes; the sign of the charge of the metallic ions; the molecular mass of complex or polynuclear compounds; and the degree of oxidation of the metal. The scope of the outline devised has been verifed in a study of the forms of the migration of manganese in the water of the Dnieper River. It has been established that manganese is in a dissolved state in the water of this river as free ions and complex compounds of different molecular mass. Macromolecular manganese complexes are represented mainly by anionic compounds, which are about 85-90% of the total content. Cationic manganese complexes are found in fractions with a molecular mass of about 0.5 to 1.5 thousand. The combining of manganese into complex compounds by the complex-forming substances in the water of the Dnieper is typified by a fairly slow rate. (Baker-FRC)
W82-05456

GEOCHEMICAL ENVIRONMENTS AND THE GEOGRAPHICAL DISTRIBUTION OF SOME DISEASES IN SRI LANKA,
Sri Lanka Univ., Peradeniya. Dept. of Geology.
For primary bibliographic entry see Field 5C.
W82-05463

THE EFFECT OF SULFATE ON ALUMINUM CONCENTRATIONS IN NATURAL WATERS: SOME STABILITY RELATIONS IN THE SYSTEM AL2O3-SO3-H2O AT 298 K,
Geological Survey, Menlo Park, CA.
D. K. Nordstrom.
Geochimica et Cosmochimica Acta, Vol 46, No 4, p 681-692, 1982. 7 Fig, 2 Tab, 93 Ref.

Descriptors: *Aluminum compounds, *Solubility, *Sulfates, Chemical reactions, Chemical precipitation, Gibbsite, Kaolinite, Hydrogen ion concentration, Minerals, Acid rain, Alunogen, Alunite, Jurbanite, Basaluminite, Acid mine drainage, Adsorption, Soil chemistry, Sediments, Clays, Water pollution effects.

In natural waters aluminum concentrations are generally regulated by gibbsite and kaolinite solubilities. However, addition of sulfate by acid precipitation or acid mine drainage can shift solubility control to less soluble minerals. These minerals include alunogen, Al2(SO4)3 x 17H2O; alunite, KAl2(SO4)2(OH)5; jurbanite, Al(SO4)(OH) x 5H2O; and basaluminite, Al4(SO4)(OH)10 x 5H2O. Values for the log of the solubility product constant obtained from the literature or estimated in this work are: alunite, -85.4; basaluminite, -117.7; alunogen, -7.0; and jurbanite, -17.8. The solubility and stability relations among these four minerals were plotted as a function of pH and sulfate activity at 298 K. Within the range of most natural waters (pH 0 to 13 and log of sulfate activity, -6 to 1) alunogen is unstable, jurbanite is stable from pH o to 5, alunite is stable from pH 3 to 7, and gibbsite, from pH 3 to 8. Basaluminite is metastable for all values of pH and sulfate activity. These equilibrium calculations predict that sulfate and aluminum can be immoblized in acid waters by precipitation of aluminum hydroxy sulfates, which rather than adsorption may be the cause of sulfate retention in soils and sediments. (Cassar-FRC)
W82-05581

FLOODWATER NUTRIENT PROCESSING IN A LOUISIANA SWAMP FOREST RECEIVING AGRICULTURAL RUNOFF,
Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
For primary bibliographic entry see Field 5C.
W82-05622

IONIC COMPOSITION OF GROUND WATERS AND THEIR DISTRIBUTION IN KARNAL DISTRICT (HARYANA).
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 5A.
W82-05721

INDICATIONS OF GROUND WATER INFLUENCES ON NUTRIENT TRANSPORT THROUGH SCHWATKA LAKE, YUKON TERRITORY,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 5B.
W82-05741

THE ORIGIN OF HIGH IRON CONCENTRATIONS IN GROUNDWATER FROM THE TRIASSIC AQUIFER IN EAST DEVON,
Institute of Geological Sciences, London (England).
N. R. G. Walton.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 63-77, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Iron, *Geochemistry, *Water quality, Chemical composition, Sherwood Sandstone,

Otter Sandstone, Budleigh Salterton Pebble Beds, Aquifers, Groundwater, Wells, Acid water.

Exploratory drilling for groundwater resources in the Sherwood Sandstone aquifer in eastern Devon, England, revealed water of anomalously high iron concentration. Total Fe concentrations were 9800, 3900, and 1400 mg per liter in the three highest-level samples and 4-230 mg per liter in the remaining 17 samples. Ferrous iron levels were 0.01-3.50 mg per liter. This was a result of interdependence between two formations. The upper formation, Otter Sandstone, acts as a confining stratum for the Budleigh Salterton Pebble Beds, promoting reducing conditions in the Pebble Beds and mobilizing iron in the ferrous form. The tendency toward natural upward flow from the Pebble Beds to the Otter formation and the acid nature of the Pebble Beds water (pH 5.0) cause the high iron levels in the mixed groundwater. To minimize Fe content in wells drilled in this region the lower Pebble Beds formation should not be penetrated or approached closely in drilling a well, except in the region within 1.5 km of the outcrop. Conditions such as faults, permeable strata, and connections between the two formations will promote leakage of Pebble Beds water into Otter Sandstone wells. Proper positioning of the well screen and careful managing of pumping regime can also help avoid excessive Fe concentrations in abstracted water. (Cassar-FRC)
W82-05801

AN EVALUATION OF THE EFFECTS OF ACID RAIN ON LOW CONDUCTIVITY HEADWATER STREAMS IN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05843

INFLUENCE OF DISSOLVED ORGANIC MATERIALS ON TURBID WATER OPTICAL PROPERTIES AND REMOTE-SENSING REFLECTANCE,
National Aerounautics and Space Administration, Hampton, VA. Langley Research Center.
W. G. Witte, C. H. Whitlock, R. C. Harriss, J. W. Usry, and L. R. Poole.
Jounral of Geophysical Research, Vol 87, No c1, p 441-446, January 10, 1982. 11 Fig, 2 Tab, 18 Ref.

Descriptors: *Dissolved solids, *Remote sensing, Turbidity, Measuring instruments, Water quality, Physical properties, Rivers, Georgia, Humic acids.

The purpose of this study was to assess quantitatively the influence of dissolved organic matter on turbid water optical properties and remote sensing reflectance over a range of concentrations typical of inland and coastal waters. Both field measurements and laboratory results were studied. Field measurements were taken of upwelled water volume reflectance on five of the major rivers of Georgia. Results implied that dissolved organic matter has the effect of reducing the inherent reflectance of turbid water mixtures, but a firm conclusion to that effect could not be made because of possible variations in uncontrolled variables such as solar elevation angle, atmospheric haze, chlorophyll, sediment mineralogy, iron content, and particulate organic carbon. Controlled lab tests were conducted in an attempt to isolate the optical effects of dissolved humic acids. The laboratory measurements showed nonlinear degradation in reflectance signals with changing dissolved organic carbon at visible and some near-infrared wavelengths, with degradation gradients greatest for dissolved organic carbon concentrations less than 3 mg/liter. Theoretical analysis, using a model relating upwelled reflectance to backscattering and absorption parameters, confirmed the nonlinear nature of the experimental results. (Baker-FRC)
W82-05869

EVALUATION OF THE RATE OF UPTAKE OF NITROGEN DIOXIDE BY ATMOSPHERIC AND SURFACE LIQUID WATER,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
Y.-N. Lee, and S. E. Schwartz.
Journal of Geophysical Research, Vol 86, No C12, p11971-11983, December 20, 1981. 2 Fig, 2 Tab, 78 Ref.

Descriptors: *Nitrogen dioxide, *Surface water, Chemical reactions, Absorption, Sulfur, Water pollution sources, Solubility, Chemistry of precipitation, Acid rain, Catalysts, Clouds.

The rate of uptake of nitrogen dioxide by liquid water was shown to be unaffected by oxygen at 0.2 atm pressure. Therefore, the rate constant and Henry's law solubility constant of nitrogen dioxide previously obtained may be used to evaluate the rates of aqueous phase reactions of nitrogen dioxide in the ambient atmosphere. Reactions are quite slow at representative atmospheric partial pressures and cloud liquid water content. The characteristic times range upward from 1000 to 10000 hours at 0.1 microatm, increasing with decreasing partial pressures of the gases. Direct acidification of cloud liquid water is also unimportant. Catalytic enhancement is potentially important for catalyst concentrations of the order of 0.1 microatm, assuming sufficiently fast rate constants. Iron-catalyzed reaction in particular was unimportant. Reaction of nitrogen dioxide with dissolved sulfur is potentially important, based on an assumed upper limit rate constant of 0.25 micromolar per sec. Deposition of nitrogen dioxide to surfaces of oceans or lakes is shown to be controlled by aqueous phase mass transport and/or reaction and is much slower than heretofore assumed. (Baker-FRC)
W82-05873

2L. Estuaries

SEDIMENT WATER EXCHANGES OF NUTRIENTS AND OXYGEN ON TIDAL FLATS IN THE EMS-DOLLART ESTUARY,
Nederlands Inst. voor Onderzoek der Zee, Texel. Biological Research Ems-Dollart Estuary.
M. M. Rutgers Van Der Loeff, F. B. Van Es, W. Helder, and R. T. P. De Vries.
Netherlands Journal of Sea Research, Vol 15, No 1, p 113-129, October, 1981. 9 Fig, 2 Tab, 50 Ref.

Descriptors: *Estuaries, *Tidal flats, *Nutrients, *Oxygen uptake, *Light penetration, *Marine sediments, Tidal marshes, Cycling nutrients, Oxygen balance, Silica, Nitrogen, Oxygen, Phosphates, Nitrate, Ammonia, Interstitial water, *Netherlands, Ems-Dollart Estuary.

The relationship between oxygen exchange and nutrient exchange on the tidal flats of the Ems-Dollart Estuary of the Netherlands was examined by bell jar experiments in an attempt to qualitatively evaluate the effect of these exchanges on the nutrient budgets of the estuary. At two sampling stations, the exchange of ammonia and silica was correlated with oxygen exchange and light conditions. Throughout the entire year, the Heringsplaat in the Dollart River was a sink for nitrate, ammonia, and silica in both light and dark periods even during periods of net oxygen consumption. The other two sampling sites showed different patterns due to a longer emersion period at the Heringsplaat and a greater supply of nutrients. In general, phosphate exchange was low, except at the Heringsplaat in June, where a release of 1 mmol/sq m/day was recorded. In the Dollard, a net release of silica in late summer was attributed to the dissolution of suspended material in the water phase. Inorganic nitrogen supplies may become depleted at the sediment surface during emersion, thereby restricting the growth of diatoms. (Geiger-FRC)
W82-04751

COMPOSITION AND DISTRIBUTION OF DISSOLVED FLUORESCENT SUBSTANCES IN THE EMS-DOLLART ESTUARY,
Nederlands Inst. voor Onderzoek der Zee, Texel. Biological Research Ems-Dollart Estuary.
R. W. P. M. Laane.
Netherlands Journal of Sea Research, Vol 15, No 1, p 88-99, October, 1981. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Estuaries, *Decomposing organic matter, *Fluorescence, Water analysis, Mixing, Salinity, Tracers, Environmental tracers, Organic matter, Distribution, Decomposition, Temperature, Hydrogen ion concentration, Phytoplankton, *Netherlands, Ems-Dollart Estuary.

From October 1978 to October 1980, the fluorescence was measured in the Ems-Dollart Estuary to characterize the mixing patterns of the waters and identify the types of matter connected with the fluorescence. It was concluded that the fluorescence originates from fluvial sources and behaves conservatively from the linearity of the inverse relation between fluorescence and salinity. At high salinity, there was an increase in fluorescence during the summer months in the outer portions of the estuary. These increases could be due to accumulated fluorescent matter due to slower decomposition at high salinities, in situ formation of fluorescent substances from the degradation of phytoplankton changes in water temperature or pH causing a disturbance in the equilibrium between dissolved particulate and dissolved fluorescent substances, or a combination of these. Ultrafiltration was performed during five surveys between February and August of 1980 to determine the polymeric character of the fluorescent matter. A fraction with molecular weight < 500 showed a high contribution to the total fluorescence for all dates. It was deemed possible for the measure of aggregation of fluorescent matter to fluctuate during transport through the estuary. (Geiger-FRC)
W82-04752

SEDIMENT TRANSPORT AND SHOALING IN ESTUARINE AND OTHER SHALLOW-WATER AREAS,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
J. C. Ludwick, and C. E. Grosch.
Ocean Science and Engineering, Vol 6, No 2, p 163-194, 1981. 88 Ref.

Descriptors: *Sediment transport, *Estuaries, *Shoals, Shallow water, Sedimentation, *Sediment distribution, Estuarine environment, Environment, Bed load, Sediment load.

This paper discusses four sediment transport formulations, with the aim of emphasizing the need to understand mechanics of the problem in spite of the present incompleteness of the solutions. Knowledge of sediment transport mechanics, particularly the sediment transport continuity equation, can increase insight into erosion and deposition. Specific discussion is offered on the Shields Bed Load transport equation, which pertains to a sediment bed on which the surface grains are in strong motion and hence no longer form a flat surface, but instead are shaped into scales or bars of low height to length ratio. Also discussed are the Einstein and Einstein-Brown equations for bed load transport, the 1950 Einstein bed load transport function, and the Bagnold 1973 formulation for bed load transport rate. (Baker-FRC)
W82-04753

MODELING: HOW AND WHEN TO USE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. H. McAnally, Jr.
Ocean Science and Engineering, Vol 6, No 2, p 149-162, 1981. 12 Ref.

Descriptors: *Model studies, *Estuarine environment, *Sedimentation, *Sediment transport, Cost analysis, Economic aspects.

In order to determine if modeling is an appropriate approach to specific problems, the physical processes contributing to a sedimentation problem must be understood. Potential sources of estuarine sediments include: upland drainage basins; the estuary itself through erosion of banks, bottoms and marshes; the ocean; municipal and industrial wastes; windborne sediment; and organic materials. Different sediments will predominate in different parts of an estuary. Estuarine sedimentation is dependent upon the supply of depositable sediment and flow conditions near the bed. Four primary

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methods are used for studying estuarine sedimentation - field methods, analytical methods, physical modeling and numerical modeling. Numerical modeling is relatively new and employs special computational methods such as iteration and approximation to solve mathematical experssions that do not have closed form solutions. Numerical modeling provides much more detailed results than analytical methods and may be more accurate, but is also more expensive and time consuming. Modeling should be employed when the cost or importance of the problem justifies the time and cost of modeling and the dominant processes involved are susceptible to modeling. Most estuarine construction projects are either very expensive or possess the potential for expensive side effects. (Baker-FRC)
W82-04754

INVESTIGATIONS ON THE SEDIMENTATION IN THE DARST-ZINGST BODDEN CHAIN - A CONTRIBUTION TO ESTABLISHMENT OF AN ENERGY AND MATTER BALANCE IN THE ECOSYSTEM. PART 2: RESEARCH ON THE SEDIMENTATION OF PLANKTON. (UNTERSUCHUNGEN ZUR SEDIMENTATION IN DER DARSS-ZINGSTER BODDENKETTE EIN BEITRAG ZUR AUFSTELLUNG EINER ENERGIE-UND-STOFFBILANZ IM OKOSYSTEM. TIEL 2: UNTERSUCHUNGEN ZUR SEDIMENTATION DES PLANKTONS),
Rostock Univ. (German, D.R.).
M. Nausch-Stengel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 71-82, 1980. 5 Fig, 8 Tab, 16 Ref. (No English summary).

Descriptors: *Sedimentation, *Zooplankton, *Phytoplankton, *Estuarine environment, Boddens, Bays, Salinity, Productivity, Detritus, *Baltic Sea, Coastal waters, Lagoons.

Complex studies on the hydrographic and biological regime have been underway in the area of the shallow bays (bodden) to the south of the Darss and Zingst peninsulas since 1969. The relationships between the water body and the sediment are especially close in shallow water areas such as those studied. In the current investigation, quantitative and qualitative studies were performed on the sedimentation of the phytoplankton and zooplankton in the western portion of the Bodstedter Bodden. The phytoplankton sedimentation rate varies with the species, but in general the groups most numerous in the water are also most common in the sediment. The two peaks observed in the phytoplankton growth in the water were reflected without time lag in the detritus (August 6 and 14, 1975). The Bacillariophyceae had the highest sedimentation rate. The sedimentation rate of the Chlorophyceae was greater than that of the Cyanophyceae, but the absolute numbers of the former were smaller. Very high zooplankton abundances were found, averaging 27,000 individuals/liter. Rotatoria represented the most common species. The organisms found were freshwater species. Interpretation due to the sporadic occurrences of some species. The small numbers of sedimenting zooplankton were balanced by their greater biomass, and relative to their occurrence in the water, larger numbers of zooplankters sedimented each day. A total mean plankton sedimentation rate accounting for 16% of the deposition volume was found. (Carroll-FRC)
W82-04761

INVESTIGATIONS ON THE SEDIMENTATION IN THE DARSS-ZINGST BODDEN WATERS - A CONTRIBUTION TO THE ESTABLISHMENT OF AN ENERGY AND MATTER BALANCE IN THE ECOSYSTEM. PART 1: THE DETERMINATION OF THE RATE OF SEDIMENTATION AND PRODUCTIVITY FACTORS OF SEDIMENTED MATERIAL (UNTERSUCHUNGEN ZUR SEDIMENTATION IN DEN DARSS-ZINGSTER BODDENGEWASSERN - EIN BEITRAG ZUR AUFSTELLUNG EINER ENERGIE- UND STOFFBILANZ IM OKOSYSTEM. TEIL 1: DIE BESTIMMUNG DER SEDIMENTATIONSRATE UND DIE ERFASSUNG PRODUKTIONSBIOLOGISCH WICHTIGER PARAMETER DES SEDIMENTIERTEN MATERIALS).
Rostock Univ. (German, D.R.).
M. Nausch-Stengl, G. Schlungbaum, and J. A. von Oertzen.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 58-69, 1980. 3 Fig, 1 Tab, 31 Ref. (No English summay).

Descriptors: *Sedimentation, *Estuarine environment, *Productivity, Chemical oxygen demand, Organic matter, Boddens, *Baltic Sea, Bays, Coastal waters, Lagoons, Shallow water, *Energy balance, Phosphorus, Iron.

The boddens to the south of the Darss and Zingst peninsulas are a system of communicating water bodies connected with the Baltic Sea and presenting estuarine conditions, with salinities decreasing with distance from the Baltic. The water is very shallow (average depth 1.7 m, maximum 12 m); wind-induced turbulence can constantly rearrange large areas of sediment surface, making sedimentation studies very difficult. Studies were conducted at a relatively sheltered site when the salinity was relatively high (0.5%) and the water was warm (average for August 1975, 18-19 C). Two types of sediment traps were used: plastic funnels and settling tubes; best results were achieved with the funnels. An average sedimentation rate of 1316 ml/sq m was measured for July/August 1975, with a dry matter content of 16.4 g/sq m. The organic matter content (loss on ignition) was 64.4% on August 1, and the COD was 786 mg 02/mg dry matter. The iron/phosphorus ratio averaged around 2.5 in freshly sedimented material. An estimation of the energy content of the sediment suggested that about 1% of the solar irradiation is initially stored in the sediment. The information obtained will be used for formulating a mathematical model of the ecosystem. (Carroll-FRC)
W82-04762

DETERMINATION OF TRACE METALS IN ESTUARINE SEDIMENTS BY GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY,
National Research Council of Canada, Ottawa (Ontario). Div of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04893

DISTRIBUTION OF METHANOGENIC AND SULFATE-REDUCING BACTERIA IN NEARSHORE MARINE SEDIMENTS,
Connecticut Univ., Noank.
M. E. Hines, and J. D. Buck.
Applied and Environmental Microbiology, Vol 43, No 2, p 447-453, February, 1982. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Bacteria, *Marine sediments, Sedimentation, Sediments, Estuarine environment, Sulfates, Population dynamics, Methanosarcina, *Long Island Sound.

Populations of both methanogenic and sulfate-reducing bacteria were investigated in various sediments of eastern Long Island Sound and contiguous waters to determine whether their distribution agreed with previous hypotheses. The findings suggested that the distribution of abundant methanogenic and sulfate-reducing bacteria were mutally exclusive in these marine sediments. Three distributional patterns were noted. Four sites exhibited methanogenic and sulfate-reducing populations which were restricted to the upper 10 to 20 cm, with a predominance of sulfate reducers. Three sites in western Long Island Sound exhibited a methanogenic population most abundant in sediments deeper than those occupied by sulfate reducers. At one site which was influenced by fresh groundwater, methanogens and sulfate reducers were numerous within the same depths, however, the number of sulfate reducers varied vertically and temporally with sulfate concentrations, Methanogenic enrichments yielded all genera of methanogens except Methanosarcina, with the methanobacteria predominating. (Baker-FRC)
W82-04894

SEASONAL DISTRIBUTION OF BDELLOVIBRIOS AT THE MOUTH OF THE PATUXENT RIVER IN THE CHESAPEAKE BAY,
Maryland Univ., Baltimore. Dept. of Microbiology.
H. N. Williams, W. A. Falkler, Jr., and D. E. Shay.
Canadian Journal of Microbiology, Vol 28, No 1, p 111-116, 1982. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Bdellovibrios, *Bacteria, *Seasonal variation, Vibrios, Rivers, *Patuxent River, *Chesapeake Bay, Marine bacteria, Predators, Estuaries.

Marine bdellovibrios, bacterial predators of susceptible gram-negative bacilli, were cultured from samples taken monthly from June 1979 to June 1980 at the end, middle, and shoreline of a pier at Solomon's Island, Maryland in the mouth of the Patuxent River, Chesapeake Bay. The number of bdellovibrios was highest in April-June and decreased to a low in January-March. With one exception the shoreline site had higher counts than the middle and end of the pier. The number of bdellovibrios was also significantly correlated with water temperature. In July-September, the mean water temperature was 26 C, slightly above the 23-25 C temperature for optimum growth. Bdellovibrios (in plaque-forming units per 10 ml) recovered at the shoreline site were: 178.8 + or - 205.5 in April-June, 158.7 + or - 145.8 in July-September, 91.8 + or - 16.0 in October-December, and 7.2 + or - 6.7 in January-March. (Cassar-FRC)
W82-04924

A NEW METHOD OF CUBATURE USING SPLINE FUNCTIONS,
Louvain Univ. (Belgium). Applied Mathematics Div.
P. Dierckx, E. Smets, R. Piessens, and M. Temmerman.
Deutsche Hydrographische Zeitschrift, Vol 34, No 2, p 61-69, 1981. 7 fig, 4 Tab, 13 Ref.

Descriptors: *Tidal basins, *Discharge measurements, *Water level fluctuations, Tidal rivers, Cubature calculations, Spline approximations, *Schelde Basin, Estuaries, River basins, Stream discharge, Flood discharge, Ebb discharge, Netherlands, Belgium.

This paper presents a new method for cubature calculations to obatin a value for river discharge which is more accurate than those obtained by measurement of current velocities. The method uses measurements of water level variations in a limited number of cross sections along with a knowledge of the geometry and upstream discharge. Spline approximations are constructed for the discharge variations in several rivers in a given tidal basin. This smooths out the effects of measuring errors. The approximations may be evaluated for any location or time in the total region. Ebb and flood volumes can be easily evaluated. The Schelde tidal basin, the Netherlands and Belgium, is used to illustrate the calcualtion procedure. (Cassar-FRC)
W82-04939

THE ECOLOGY OF PLANKTON FAUNA IN SALINE RIVER POOLS,
Western Australia Inst. of Tech., Perth. Dept. of Biology.
R. J. Rippingale.
Hydrobiologia, Vol 82, p 223-232, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Saline water, *Plankton, *Estuaries, Fauna, Benthic fauna, Rivers, Ponds, River pools, Salinity, *Swan-Avon River system, *Australia.

The occurrence of a planktonic copepod typical of estuaries in pools of the Swan-Avon river system is investigated. Plankton samples were taken from a number of pools during 1972 and 1979. Any discussion of the mechanism for the initial recruitment of an estuarine fauna into saline river pools during this century can only be speculative. Upstream penetration could not have occurred due to rapids and periods at which the river bed is dry. One transport mechanism which is possible would in-

volve the use of waterfowl. However, recriutment must be a continual event, as the Sulcanus conflictus could not survive winter floods in this area. The fact that dense populations of adult S. conflictus frequently dominate the saline pools is explained by their omnivorous feeding habit. S. conflictus exploits phytoplankton in the estuaries and saline river. Thus with the ability to survive both as a filter feeder and a predator, and with significant tolerance to low environmental salinities, S. conflictus was able to extend its range into the saline pools of the Avon River when this habitat became available during historical times through increase in groundwater salinities. (Baker-FRC)
W82-04941

A SYSTEM FOR MEASURING METHANE FLUXES FROM INLAND AND COASTAL WETLAND ENVIRONMENTS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
D. I. Sebacher, and R. C. Harriss.
Journal of Environmental Quality, Vol 11, No 1, p 34-37, January-March, 1982. 3 Fig, 30 Ref.

Descriptors: *Wetland, *Methane, Measuring instruments, *Air-water interfaces, Interfaces, Fluctuations, Monitoring, Bayous, Bogs, Fens, Marshes, Muskeg, Swamps, *Tide lands, Estuaries.

A simple monitoring system for measuring methane fluxes at the water-air interface in wetland environments has been developed and field tested. The system permits precise detection of methane emission rates as low as .0001 g methane per square meter per day in 5 minutes or less. Systematic studies on the importance of methane in the carbon budget of flooded agricultural soils, wetland waste management sites, salt marshes and inland wetlands may be possible. The method employs a partitioned chamber placed over the water surface where the air velocity along the surface can be controlled. Emission rates of gas across an air-water interface are controlled by shear stress of winds in the overlying gas. Therefore the objective of the present studies was to develop a relatively simple field system with the capability of quantitatively controlling air velocity over water surface within the chamber sampling area. The technique has the important advantage of including a continuous monitoring system so that data can be observed on site. Measurements obtained in a coastal wetland creek demonstrated that the methane flux passing through a water-atmosphere interface can be quantified as a function of air velocity over the water surface. (Baker-FRC)
W82-04989

SEVERAL PLUME FLOWS IN PURE AND SALINE WATER AT ITS DENSITY EXTREMUM,
State Univ. of New York at Buffalo, Amherst. Dept. of Mechanical and Engineering Aerospace.
For primary bibliographic entry see Field 2E.
W82-05088

A NOTE ON THE STRUCTURE OF THE HEAD OF AN INTRUSIVE GRAVITY CURRENT,
Cambridge Univ. (England). Dept. of Engineering.
For primary bibliographic entry see Field 2E.
W82-05089

COMPOSITION OF ESTUARINE COLLOIDAL MATERIAL: MAJOR AND TRACE ELEMENTS,
Maryland Univ., College Park. Dept. of Chemistry.
A. C. Sigleo, and G. R. Helz.
Geochemical et Cosmochimica Acta, Vol 45, No 12, p 2501-2509, December, 1981. 6 Fig, 4 Tab, 38 Ref.

Descriptors: *Chemical composition, *Colloidals, *Estuaries, Trace levels, Seasonal variation, Aluminum carbon, *Patuxent River, *Maryland.

Instrumental neutron activation analysis was used to analyze colloidal sized material from the Patuxent River estuary, in Maryland, for more than 30 elements, Data on samples taken from five stations, ranging in salinity from 0.04 grams per kiogram (g/kg) to 12 g/kg, in February and June indicate that the winter colloidal material is dominated upstream by poorly crystallized clay minerals and iron oxide, but that it consists primarily of carbonaceous material at salinities over 10 g/kg. During the winter, colloidal material decreases non-conservatively seaward from 29 to 0.6 milligram per liter. The summer colloidal material was found to be carbon-rich throughout the estuary and the amount of colloidal material in the upper water column did not change significantly with increasing salinity. Trace elements which covary with aluminum, including cesium, hafnium, rubidium, scandium, thorium, vanadium, and the REE, are probably associated with the clay component of the colloidal material. Other elements, including selenium, arsenic, barium, uranium, and zinc, were considerably enriched relative to aluminum and may covary with the organic component. These findings suggest that while the freshwater summer colloidal material is derived primary from estuarine biological processes, the winter colloidal system is a product of continental weathering processes. (Carroll-FRC)
W82-05137

EXPERIMENTAL STUDIES TO DETERMINE THE FATE OF PETROLEUM HYDROCARBONS FROM REFINERY EFFLUENT ON AN ESTUARINE SYSTEM,
Bermuda Biological Station, St. Georges West.
For primary bibliographic entry see Field 5B.
W82-05144

THE TRANSPORT TO AND DEPOSITION OF AMERICIUM IN INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY AND ITS RELATIONSHIP TO PLUTONIUM,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-05178

MODELLING AND CONTROL OF DISSOLVED OXYGEN IN AN ESTUARY,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Electrical Engineering.
For primary bibliographic entry see Field 6A.
W82-05188

A NEW METHOD OF CUBATURE USING SPLINE FUNCTIONS,
Louvain Univ. (Belgium). Applied Mathematics Div.
P. Dierckx, E. Smets, R. Piessens, and M. Temmerman.
Deutsche Hydrographische Zeitschrfit, Vol 34, No 2, pp 61-79, August, 1981. 4 Tab, 7 Fig, 13 Ref.

Descriptors: *Discharge, *Floods, *Tides, *Mathematical studies, *Cross-sections, Tidal floods, Time series analysis, Basins, Flood basins, Equations, Simulation analysis, Seasonal variation, Hydrographs, Velocity, Flow discharge, Flood data, *Cubature, Water level fluctuations.

A new method for cubature calculations is presented. The cubature requires measured water-level variations in a limited number of cross-sections and knowledge of the geometry and of the upstream discharge as a boundary condition. By numerical integration of the continuity equation, spline approximations are constructed for the discharge variations in the different rivers of a given tidal basin. In that way measuring faults and their efects are smoothed out. Once the approximations are obtained, they can be evaluated in a quick and accurate way for any location in the tidal region and at any time. Derived quantities as ebb- and flood-volumes can be evaluated likewise, in a very simple procedure. A computer program based on this method is described. Some results from the basin of the Schelde estuary in the Netherlands and Belgium are presented; they confirm the validity of the method. (Titus-FRC)
W82-05189

THE TIDAL STREAM IN THE GERMAN BIGHT,
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
C. Brockmann, W. Lange, E. Mittelstaedt, and K. C. Soetje.
Deutsche Hydrographische Zeitschrift, Vol 34, No 2, pp 56-60, August, 1981. 1 Tab, 4 Ref.

Descriptors: *Bights, *Bays, *Estuaries, *Currents, *Time series analysis, Sounds, Estuaries, Hydrologic data, Water depth, Mathematical models, *German Bight, Tidal effects, Tidal currents.

A numerical model of the German Bight is presented and current measurements are compared with the model results. The model is three-dimensional with four layers in the German Bight, and two-dimensional in the coupled North Sea. Tidal stream vectors resulting from the model are compared with data obtained over a twenty year period for hourly intervals in spring high water conditions. Spring conditions were chosen for simulation because during this time the diurnal inequalities of the tides are minimum. The model currents compare well with the observed tidal streams in areas with water depths greater than 10 meters. In shallower regions local topographic differences influence currents. (Titus-FRC)
W82-05190

INITIAL COLONIZATION OF ARTIFICIAL SUBSTRATE: COMMUNITY DEVELOPMENT AND STRUCTURE STUDIED BY SCANNING ELECTRON MICROSCOPY,
Laval Univ., Quebec. Dept. de Biologie.
C. Hudon, and E. Bourget.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1371-1384, November, 1981. 7 Fig, 7 Tab, 49 Ref.

Descriptors: *Substrates, *Population dynamics, *Estuaries, Bacteria, Diatoms, Electron microscopy, Intertidal areas, Canada, *St. Lawrence Estuary.

A 90 kilometer section of the south shore of the lower St. Lawrence Estuary, which is influenced by strong semidiurnal tides, was used for a quantitive study of the community development and biological interactions occurring in a slow-growing, low-density periphytic assemblage. The initial phases of the subtidal and intertidal community development were observed using scanning electron microscopy on samples from plastic panels immersed monthly in the estuary between May and November 1978. The community structure was significantly influenced by the pattern of immersion and/or periodical emersion. Subtidal panels were rapidly colonized by bacteria, while diatoms settled 2 to 7 weeks later, depending on the season. All dominant species formed well-defined, generally monospecific clumps until mid-September. Clump overlap and increased species interactions occurred with higher cell densities. In the intertidal zone, bacteria settled after 8 to 12 weeks, while the only diatom species able to resist semidiurnal emersion, Achnanthes brevipes, appeared after 20 weeks. Panels emersed only at spring tides (monthly) were rapidly colonized by bacteria, with heavy diatom settlement occurring within 4 weeks. These diatom populations were eliminated or strongly reduced by successive monthly emersions and were replaced by filamentous algae. The various types of communities are compared and the strategic advantages of vertical growth discussed with reference to population density, light availability, and detrital cover. (Carroll-FRC)
W82-05193

DISTRIBUTION OF SUSPENDED SEDIMENT IN THE PATUXENT RIVER, MARYLAND DURING DREDGING OPERATIONS FOR CONSTRUCTION OF A PIPELINE,
Columbia Gas System Service Corp., Wilmington, DE.
For primary bibliographic entry see Field 2J.
W82-05198

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THE ECOLOGY OF SOUTHERN CALIFORNIA COASTAL SALT MARSHES: A COMMUNITY PROFILE,
San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-05215

DYNAMIC ESTUARY MODEL PERFORMANCE,
Environmental Research Lab., Athens, GA.
R. B. Ambrose, Jr., and S. E. Roesch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 51-71, February, 1982. 5 Fig, 7 Tab, 17 Ref.

Descriptors: *Estuaries, *Model studies, Mathematical models, Estuarine environment, *Delaware Estuary, *Potomac Estuary, Water quality, Sediment transport, Hydrodynamics, Mass transfer, *Tidal effects, Inflow, Rainfall impart, *Stream discharge.

This report evaluates how well the dynamic estuary model (DEM) simulates historical hydrodynamic, mass transport, and water quality data in the Delaware and Potomac Estuaries. The Delaware and Potomac Estuaries are drowned river valleys. Well-defined heads-of-tide are located at the fall line between the piedmont and coastal plain. Freshwater inflow controls the net seaward advection. Wind stress adds a significant stochastic variation. Dredging is required to maintain navigational channels. The Delaware Estuary application of the DEM yielded coefficients of variation between 2% and 10% for the most important hydrodynamic variables, between 13 and 45% for the important transport variables, and between 15 and 41% for the water quality variables. The Potomac Estuary application gave coefficients of variation from 5 to 7% for the hydrodynamics, 5 to 44% for the transport, and 11 to 267% for water quality. The Potomac water quality response falls between 11 and 90%. Correlation coefficients showed the same trends. These statistics reveal the DEM to be basically reliable when operated within the range of conditions for which it is calibrated and tested. Certain limitations should be remembered. The model cannot reliably predict transient or steep concentration gradients with precision exceeding 5 kilometers or three hours. Above these limits the model is limited by the precision of the input data and the nature of the water quality structure implemented. The model should be able to predict relative changes in water quality expected from incremental wastewater management alternatives. (Baker-FRC)
W82-05319

CONTAMINANT DISPERSION IN OSCILLATORY FLOWS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5B.
W82-05631

WETLANDS AND DEEPWATER HABITATS: A NEW CLASSIFICATION,
Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
L. M. Cowardin.
Journal of Soil and Water Conservation, Vol 37, No 2, p 83-85, March/April, 1982. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Wetlands, *Classification, *Habitats, Marshes, Swamps, Vegetation, Hydrophytes, Soil types, Water chemistry, Lakes, Rivers, Estuaries, Marine environment, Aquatic habitats, Deep-water habitats.

A new classification system for wetlands and deep water habitats was developed by the Fish and Wildlife Service starting in 1974 with a national wetlands inventory. The system is hierarchical (system, subsystem, class, subclass). The first level (system) includes marine, estuarine, riverine, lacustrine, and palustrine. These are further divided into subsystems: subtidal and intertidal for marine and estuarine; tidal, lower and upper perennial, and intermittent for riverine; and limnetic and littoral for lacustrine. Classes include some of the following, depending on the subsystem: rock bottom, unconsolidated bottom, aquatic bed, reef, rocky-shore, unconsolidated shore, streambed, emergent wetland, scrub-shrub wetland, forested wetland, and moss-lichen wetland. Classes are defined by form of vegetation or substrate composition. Modifying terms are used with the classes--water regime, water chemistry, soils, and dominance type. Classes are divided into subclasses on the basis of the same attributes used to form classes. An example of the classification of a specific Massachusetts salt marsh is as follows: System: Estuarine; Subsystem: Intertidal; Class: Emergent wetland; Subclass: Intertidal; Subclass: Persistent; Water regime: Regularly flooded: Water chemistry: Mixohaline; Soil: Organic (Sulfihemist); and Dominance type: Spartina alterniflora. (Cassar-FRC)
W82-05716

PHYSICOCHEMISTRY OF WATER IN THE ST. LAWRENCE GULF AND ESTUARY (PHYSICO-CHIMIE DES EAUX DU GOLFE ET DE L' ESTUAIRE SAINT-LAURENT),
Quebec Univ., Rimouski. Inst. National de la Recherche Scientifique.
For primary bibliographic entry see Field 5B.
W82-05763

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES. II. KNYSNA RIVER,
National Physical Research Lab., Pretoria (South Africa).
For primary bibliographic entry see Field 5B.
W82-05897

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VTE/VC FOR SEA WATER,
Envirogenics Systems Co., El Monte, CA.
C. H. Hughes, and D. K. Emmermann.
Chemical Engineering Progress, Vol 77, No 7, p 72-73, July, 1981. 2 Fig.

Descriptors: *Desalination plants, *Evaporation, *Distillation, *Seawater, Vertical tube evaporation, Vapor compression, Energy, Reverse osmosis, Multistage flash distillation, Heat transfer.

A combined vertical tube evaporation and vapor compression process has been applied to sea water desalination. Since the performance ratio of this process increases almost linearly with the number of effects in the unit, the process has an advantage over multistage flash distillation when energy is at a premium. For a 24-effect process the practical performance ratio of 21 is raised to 42 by passing the boiler steam through a turbine to drive the vapor compressor of the topping effect. The compressor elevates the saturation temperature of the stream so it can be used as heating steam in the same effect. The vapor condensed in the topping effect increases total distillate production by 100% with no increase in heat. This process has been incorporated in a barge-mounted plant capable of producing 5000 cu m of water per day. It also uses partial softening of seawater feed by ion exchange pretreatment. (Cassar-FRC)
W82-04909

RECONNAISSANCE SAMPLINGS AND CHARACTERIZATION OF AQUATIC HUMIC SUBSTANCES AT THE YUMA DESALTING TEST FACILITY, ARIZONA,
Geological Survey, Denver, CO. Water Resources Div.
R. L. Malcolm, R. L. Wershaw, E. M. Thurman, G. R. Aiken, and D. J. Pinckney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-177965, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-42, 1981. 79 p, 9 Fig, 31 Tab, 21 Ref.

Descriptors: Fulvic acids, *Reverse osmosis, *Mmbrane processes, Chromatography, Chlorination, Clay minerals, *Desalination, Fouling, Water quality, Chemical analysis, *Arizona, *Yuma Desalting Test Facility.

Smectite clay minerals were found to be the principal compound on the surface of the cellulose-acetate, reverse-osmosis membranes at the Yuma Desalting Test Facility. These clay minerals were not present in the pumped ground water, but were blown into the conveyance canal from adjacent soils. Humic substances from the water and suspended sediments were associated with the clay films on the membrane, but no definitive results concerning their role in fouling were achieved. Microbial fouling is believed to be only a minor aspect of membrane fouling. Chemical and physical changes in humic substances were extensively studied at four points in the water-treatment process. Humic substances accounted for the largest component (over 25 percent) of organic constituents. Humic substances in the canal source water were similar to other aquatic humic substances present in natural waters. During the treatment process, these substances are brominated and decolorized. The effect of these halogenated humic substances on membrane fouling is unclear, but their presence in the reverse-osmosis product water and reverse-osmosis reject brine, along with volatile trihalomethanes, has led to environmental concerns. (USGS)
W82-04983

LOW TEMPERATURE EVAPORATION PLANTS,
Isreal Desalination Engineering Ltd., Tel-Aviv.
D. Hoffman.
Chemical Engineering Progress, Vol 77, No 10, p 59-62, October, 1981. 6 Fig.

Descriptors: *Desalination, *Distillation, *Evaporation, Seawater, Saline water, Temperature, Vapor compression distillation, Scaling, Low temperature operation, Energy, Heat transfer, Wastewater treatment, Corrosion.

Low-temperature plants for seawater distillation have significant advantages over conventional distillation plants. These low-temperature plants commonly operate at 30-55 C with a maximum of 75 C. At these temperatures scale formation from non-acid soluble scalants (magnesium hydroxide and calcium sulfate) and soft acid-soluble calcium carbonate scales is minimized, allowing operation up to 2.5 years without cleaning. In addition, low cost PVC and other plastics may be used. A relatively inexpensive aluminum alloy, superior in heat transfer and corrosion resistance, may be used in place of copper-nickel alloys or steel. Low-temperature vapor compression plants require small feed heat exchangers, little or no insulation, no make-up heat, and permit quick start-up. The same features are applied to multi-effect distillation plants. A 2000 cu m per day plant operates on heat rejected from a 20-MW diesel generator station. The only other energy requirements are 1.5 kW per hour per cu m for process pumping. Concentrators operating at low temperatures can concentrate brackish water by a factor of 300 to 1 (99.5% product recovery) and seawater by a factor of 7 to 1 (85% product recovery). These concentrators produce a distillate of < 5 ppm total dissolved solids and are readily incorporated in zero discharge disposal systems for cooling tower blowdown and other effluents. (Cassar-FRC)
W82-05118

FOAM FRACTIONATION-FLOTATION AS PARTIAL PRETREATMENT FOR REVERSE OSMOSIS,
H. H. Sephton, and D. P. Antonoff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224676, Price codes: A03 in paper copy, A01 in microfiche. Report, July 1981. 25 p, 6 Fig, 5 Tab, 19 Ref. OWRT S-0075(No 7539(1), 14-34-0001-7539.

Descriptors: *Reverse osmosis, *Foam separation, *Flotation, *Pretreatment of water, *Desalintion, Water quality, Water treatment, Membranes, Turbidity, Coastal waters, Baseline studies, Membrane processes, Seawater, Clarification, Filtration, Saline water, Surface tension, Conductivity, Technology, San Francisco Bay water.

Foam flotation equipment designed, constructed, and tested to assess its utility as a partial pretreatment method on San Francisco Bay water prior to its desalination by reverse osmosis (RO). Test data obtained from a dual-flow facility revealed that foam flotation is effective in reducing feed turbidity, usually by a factor of five (ranging from 3-fold to 10-fold) in terms of national turbidity units. However, due to the poorly-matched single pair of RO units employed, the results could not detect whether feed clarity improvement significantly affected the flux decline or quality of the desalted water produced by RO. The dual-flow facility was comprised of two pretreatment and RO trains and was used for simultaneous comparative testing of conventional cartridge filtration and for the further foam flotation clarification, followed by RO applied to both pretreated feed streams. Surface tension, membrane plugging, and water conductivity were also monitored. The results of this study indicate that further evaluation using well-matched pairs of RO ion-exchange membranes is justified. (Zielinski-MAXIMA)
W82-05290

RESEARCH ON PIEZODIALYSIS - SIXTH REPORT,
Ionics, Inc., Watertown, MA.
R. B. Hodgdon, S. S. Alexander, and C. M. Swenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224692, Price codes: A04 in paper copy, A01 in microfiche. Report, December 1975. 49 p, 9 Fig, 6 Tab, 4 Ref. OWRT (No 3248)(1), 14-30-3248.

Descriptors: *Desalination apparatus, *Polyelectrolytes, *Membranes, *Ion exchange, *Baseline studies, Desalination, Anions, Cations, Saline water, Seawater, Enrichment, Ion transport, Anion exchange, Cation exchange, Membrane filters, Water treatment, Water quality, Water quality control.

Two new types of double polyelectrolyte membranes were developed and tested for their application in the desalinization of water by piezodialysis. Membrane I was a fixed (crosslinked) anionic ion-exchanger membrane filled with soluble (linear) cationic polyelectrolyte; membrane II was a fixed cationic ion-exchanger membrane filled with fixed anionic ion-exchanger sites or islands, representing a true mosaic membrane. Both membrane types had their polyelectrolyte island at/near 0.1 micron diameter. Both types showed capability for salt enrichment under applied pressure, while mosaics having polyelectrolyte islands of only 0.003 microns failed to give salt enrichments. Pressure, anion-cation capacity ratios, crosslink density, pore volumes, and salt concentrations were the most important variables affecting salt enrichment. While salt enrichments of these new membranes were less than for latex-polyelectrolyte membranes studied earlier, the new membranes can be easily and reproducibly prepared without mosaic polyelectrolyte loss. Membranes having desalting capacities of 6000-500 ppm NaCl at a production rate of 1 gallon/sq ft/day should be feasible. (Zielinski-MAXIMA)
W82-05294

PARAMETRIC ANALYSIS OF DIRECT-CONTACT (PISTONLESS) WORK EXCHANGER FOR REVERSE OSMOSIS APPLICATIONS,
Hittman Associates, Inc., Columbia, MD.
H. M. Curran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224825, Price codes: A08 in paper copy, A01 in microfiche. Final Report, HIT-580, August, 1974. Hittman Associates, Inc., Columbia, MD. 69 p, 24 Fig, 13 Tab, 10 Ref, 1 Append. OWRT C-(No 3264)(1), 14-30-3264(1).

Descriptors: *Economic evaluation, *Cost-benefit analysis, *Mechnical engineering, *Desalination, *Reverse osmosis, *Energy transfer, Parametric hydrology, Flow system, Flow discharges, Economic feasibility, Economic justification, Economic efficiency, Economic prediction, Energy loss, Energy dissipation, Cost analysis, Electric power costs, Estimated costs, Operating costs, Flow discharge, Flow rates, Brine disposal, Saline water.

A direct-contact (pistonless) work exchanger concept was analyzed parametrically to determine its economic potential as an alternative to the hydraulic turbine for recovery of flow work from high pressure brine streams discharged by reverse osmosis (RO) plants. The results showed that, for the use of work exchangers to recover energy from RO brine discharges, the break-even unit cost of electric energy increases as the brine volumetric flow rate decreases. Hence, the most cost-effective applications are those with high brine flow rates. The break-even cost at which the exchanger starts to provide a net unit water cost reduction ranges from about $0.004/Kw-hr (for a 1.3 million gallons/day (MGD) RO seawater plant with 1500 psig module inlet pressure, concentration ratio of 2, and brine flow rate of 1000 gallons/minute (gpm), to about $0.058/Kw-hr (for a 0.05 MGD RO brackish water plant with 500 psig inlet pressure, concentration ratio of 5, and brine flow rate of 10 gpm). The results indicate that these exchangers apply best in large seawater RO plants operating at high pressure and low concentration ratio. Energy recovery in cost-effectiveness for such exchangers, however, is only equivalent to hydraulic turbines for flows below 100 gpm, and is less cost-effective above 100 gpm. (Zielinski-MAXIMA)
W82-05309

FABRICATION AND CHARACTERIZATION OF METAL MEMBRANES HAVING PORE CHARGE CONTROL FOR DESALINATION,
Allied Chemical Corp., Idaho. Idaho Chemical Programs-Operations Office.
G. L. Booman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224890, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1977. 12 p, 1 Tab. 14-01-0001-1291.

Descriptors: *Desalination apparatus, *Desalination, *Membranes, *Pore size, *Water treatment, Saline water, Membrane processes, Membrane filters, Filters, Pores, Water quality, Water quality control, Thin films, Brines, Seawater, Electrodialysis, Electro-osmosis, Electrical potential, Metallurgy.

Research studies assessed the soundness of the basic principle of using charged metal membrane separation for water desalination, and compared the effectiveness of the metal membranes with currently-available membranes. Desalination by charge control of metal membranes was experimentally verified as a sound concept. While only dilute KCl solutions illustrated the desired salt rejection of greater than 99%, extension of this new technique to seawater compositions should be feasible with refinement of the membrane fabrication technique for 100 A (or similar) pore diameters in the electrically-controlled metal layer of the membrane. Fabrication of suitable metal membrane structures made use of microelectronics industry technology, with radio frequency sputter deposition as the primary method for thin film formation. Plasma etching, high temperature diffusion, fission fragment damage track etching, and various chemical etching procedures were used to fabricate appropriate structures. The use of microporous metal membrane structures for desalination would have unique advantages with respect to chemical resistance, cleaning ease, absence of compaction, thermal stability, biological inactivity, dry storage, and direct control of pore geometry for optimizing to specific applications. A U.S. patent (3,794,174; 'Porous Metal Insulator Sandwich Membrane') covering the charged metal membrane desalination concept evolved from this work. (Zielinski-MAXIMA)
W82-05314

OPERATING EXPERIENCES ON A REVERSE OSMOSIS PLANT WHICH CONVERTS SEA WATER INTO BOILER FEED WATER,
I. Vera.
Industrial Water Engineering, Vol 18, No 6, p 22-29, November/December, 1981. 4 Fig, 4 Tab, 2 Ref.

Descriptors: *Desalination, *Reverse osmosis, Membranes, Electric powerplants, Boiler water, Water treatment, Operating costs, Seawater, Venezuela.

The National Electric Company of Venezuela (CADAFE) operates a surface sea water reverse osmosis desalting plant, producing 1.7 mgd as of the end of 1981. The treated water, wiith less than 100 mg per liter total dissolved solids, is used as boiler feed water and potable water. The installation is expensive to operate, $7.63 per 1000 gal vs. $2.30 per 1000 gal for surface water (if it were available). Costs could be reduced further by prolonging the membrane performance and life. This may be attained by optimizing the pretreatment process, both equipment and chemical dosage. Problems encountered in maintaining a low turbidity feed to the membranes have been: large variation in raw water turbidity, accumulation of sediments at the seawater intake, occasional plugging of chemical feed lines, use of polyelectrolyte which had exceeded its shelf life, and improper frequency of filter backwash. Poor membrane performance was evident during early 1980. It was determined that iron corrosion products in the pumping system were fouling the membranes. Replacement of booster pump barrels with stainless steel eliminated fouling and improved membrane performance. (Cassar-FRC)
W82-05509

WATER AND SALT TRANSPORT IN MEMBRANES,
Michigan Technological Univ., Houghton. Dept. of Chemistry and Chemical Engineering.
K. S. Spiegler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232026, Price codes: A04 in paper copy, A01 in microfiche. Report, July 1981. 65 p, 20 Fig, 6 Tab, 48 Ref. C-80319-S(8539)(1). 14-34-0001-8539.

Descriptors: *Membrane processes, *Membranes, *Ion transport, *Theoretical analysis, *Desalination, Ion exchange, Ions, Salt rejection, Saline water, Saline-freshwater interfaces, Permeability, Permeability coefficient, Hydraulic conductivity, Electrolytes, Conductivity, Electrical properties, Hydraulic permeability, Experimental design, Waste transport, Experimental data.

Detailed theoretical aspects and experimental studies in membrane transport of water and salt are discussed. Accurate measurements were made of the isothermal transport of ions and water across a synthetic ion-exchange membrane. Conductivity probe-activated automatic feedback mechanism was employed in which electrolyte transport was determined from the amounts of electrolyte and water that needed to be added to and/or withdrawn from the half-cells separated by the membrane in order to keep the solution concentraton constant. Four types of experiments (electric conductivity; hydraulic permeability and streaming potential; electromigration and electroosmosis; and osmosis, dialysis, and membrane potential) were conducted, leading to the determination of eight independent transport coefficients using the developed apparatus. Membrane systems separated by two dilute NaCl solutions in which Ag-AgCl electrodes were immersed, permitted the checking of two reciprocity relations. These two reciprocities were found to hold for a cation-exchange membrane (CEM) studied, with the highest NaCl concentration being 0.5N. Comparing the conductance coefficients obtained with this CEM to those of another membrane indicated that the CEM had higher permeability characteristics. (Zielinski-MAXIMA)
W82-05537

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Group 3A—Saline Water Conversion

THE ROLE OF DESALTING TCHNOLOGY IN WATER SUPPLY, WASTEWATER REUSE AND INDUSTRIAL APPLICATIONS,
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236571, Price codes: A13 in paper copy, A01 in microfiche. Compilation of papers presented at four Technology Transfer Workshops, coordinated by the National Water Supply Improvement Association, November, 1981. 272 p, 72 Fig, 39 Tab.. C-80360-T(No 8709)(1),14-34-0001-8709.

Descriptors: *Desalination, *Conferences, *Water supply, *Industrial water, *Technology transfer, *Water supply development, Demineralization, Wastewater renovation, Water reuse, Water use, Technology, Water resources development, Water conveyance, Water requirements, Water conservation, Water demand, Civil engineering.

A compilation of papers presented at four 1978-79 technology transfer workshops on 'The Role of Desalting Technology in Water Supply, Wastewater Reuse and Industrial Applications' is presented. The material covered is focused towards the enhancement of water resources through technological applications of water demineralization. The papers are segregated into three major categories: overview; case histories; Federal and State programs. Participants of the workshops represent a cross-section of the water desalting industry, including engineering consultants, Federal, State, and local water engineers and managers, and representatives of water treatment equipment. As availability of usable water resources decreases and water demand increases, planners must consider greater use of advanced technologies for desalination and wastewater reclamation. Demineralization of brackish ground and domestic wastewater and seawater conversion are existing activity areas that need technological and practical growth. Topics considered include: desalting processes and pretreatment; wastewater reuse and groundwater recharge; reverse osmosis operations; industrial wastewater recovery through vapor compression evaporation; current and future desalting technology; desalination programs of the U.S. Department of Interior's Office of Water Research and Technology; and desalting operations in various localities (Virginia, Arizona, Texas, Colorado, California). (Zielinski-MAXIMA)
W82-05543

FIELD TEST EVALUATION RESEARCH AND DEVELOPMENT AND OPERATION AND MAINTENANCE OF REVERSE OSMOSIS SYSTEMS AND ELECTRODIALYSIS PILOT PLANTS AT ROSWELL TEST FACILITY.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236696, Price codes: A11 in paper copy, A01 in microfiche. First Annual Report, October, 1980. 212 p, 8 Fig, 92 Tab, 1 Append. OWRT C-(No 8515)(1), 14-34-0001-8515.

Descriptors: *Field tests, *Reverse osmosis, *Electrodialysis, *Pilot plants, *Feedwater treatment, Membrane processes, Test facilities, Pretreatment of water, Water tratment, On-site tests, Sites, Clarified water, Chlorination, Wastewater treatment, Water purification, Wastewater facilities, Microbiological studies, Desalination, Saline water, Brines, Management planning.

The primary objective of this work is to provide field evaluation testing of the reverse osmosis (RO) and electrodialysis (ED) pilot plants at the Roswell test facility (RTF). This report describes the blend systems, pretreatment systems, and pilot plants, and provides detailed information and test data on the performance of the pretreatment systems and pilot plants. Results of on-going research and development work on microbiological determination and control and details of the mechanical maintenance program are included. Four separate pretreatment and blend systems (a chlorinated and a nonchlorinated feedwater blend system, and two simulated feedwaters) were assessed at the RTF during the past year. In addition, activities were conducted in the operation and maintenance of 14 specific tests concerning RO systems, subsystems, test loops, and the ED reversal pilot plant. These tests included: long-term high-recovery performance evaluation with the RO stage using softened RO brine feedwater and use of concentrated brines for softener regeneration; independent evaluation of membrane performance using a simulated feedwater; evaluation of feedwater containing about 3000 ppm total dissolved solids with/without iodine; tests with/without chlorine; and tests on bacteriological effects. Detailed chemical and physical analysis results on the feedwaters and products are provided. (Zielinski-MAXIMA)
W82-05555

FURTHER RESULTS ON THE PERFORMACE OF PRESENT-DAY OSMOTIC MEMBRANES IN VARIOUS OSMOTIC REGIONS,
InterTechnology/Solar Corp., Warrenton, VA.
G. D. Mehta.
Journal of Membrane Sciences, Vol 10, No 1, p 3-19, 1982. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Osmosis, *Membranes, Wastewater treatment, *Reverse osmosis, *Membrane processes, Pressure retarded osmosis, Brines, Electric power generation, Saline water.

The performaces of osmotic membranes from several manufacturers were evaluated in osmosis, reverse osmosis (RO), and pressure retarded osmosis (PRO). Flat sheet, spiral-wound minimodules and hollow fiber minipermeators were tested for the purpose of concentrating brine in a salinity power system. Fourteen flat sheet membranes had a 1.2 to 3.0 times lower water permeation coefficient in osmosis than in RO. At higher osmotic pressures and with osmotic pressure on the porous substructure side, the water permeation coefficient in osmosis decreased. There was no permanent damage to the membrane. The UOP 4-port spiral-wound RO minimodule made of cellulose acetate was usable in PRO. However, performance was one order of magnitude less than required for economical power generation in a salinity gradient system. Water permeation coefficients (in cu m per sq m per day per atmosphere) were 0.015 for RO and 0.002 for PRO at lower pressures and 0 to 0.001 for PRO at higher pressures. The DuPont Permasep B-9 RO hollow fibers using potassium alum as the solute at 50-60 C in PRO had water permeation coefficients of 0.003, only 18% of that in RO with NaCl at the same temperatures. Since most osmotic membranes are manufactured for RO, it will be necessary to improve the performance of membranes for use in PRO. (Cassar-FRC)
W82-05660

SEAWATER RO HEADS JAPAN'S WATER REUSE RESEARCH.
World Water, Vol 5, No 3, p 29, 31-32, March, 1982. 4 Fig, 2 Tab.

Descriptors: *Water reuse, *Reverse osmosis, *Desalination, Water conservation, Wastewater treatment, Seawater, Industrial water, Wastewater renovation, *Japan, Membranes, Advanced wastewater treatment, Sludge treatment, Reclaimed water.

The Water Reuse Promotion Center (WRPC) was established in Japan in 1973 to promote desalination technology in that country and abroad. As of January 1981 reverse osmosis accounted for 56.4% of installations, electrodialysis for 23.9%, and distillation for 19.7%. Reverse osmosis research and full-scale operations are active in Japan. In addition, several companies and cities remove salts from municipal sewage effluents to allow their reuse as industrial water. In Mitsubishi's 60-story building, a maximum of 1700 cu m per day of building wastewater is automatically treated for use in toilet flushing. The WRPC is also active in research involving wastewater treatment and sludge treatment and in data collection. (Cassar-FRC)
W82-05756

3B. Water Yield Improvement

FROGMEN'S SUBTERRANEAN SWIM SITES SOURCE,
For primary bibliographic entry see Field 8A.
W82-05501

RICE REIGNS SUPREME AS INDONESIA BUILDS UP THE SAWAHS,
World Water, Vol 5, No 2, p 22-23, February 1982. 2 Fig.

Descriptors: *Irrigation, *Water demand, Farming, Rice, Water supply, Water resources development, Indonesia, Java.

Improved and increased irrigation which has directed water onto every available strip of fertile land, particularly in Java, may make Indonesia self-sufficient in rice supply by the early 1980s. The Kali Progo project in the special province of Jogjakarta is typical of the large scale irrigation schemes being implemented. Population in the project area is 1,200/square km, and there is an urgent need to increase cropping capacity to enable farmers to live. To obtain optimum water flow the system required complete rehabilitation of canals, Construction of volcanic debris check dams and flood diversion channels, remodeling of major intakes, and reconstruction of a number of tributary weirs. The project stretches across a 30 km wide swathe of land containing a sawah area of 103,000 ha, fed by two main canals, the Kalibawang and the Mataram. (Baker-FRC)
W82-05502

CAN HARD-ROCK WELLS SOLVE AFRICA'S IRRIGATION PROBLEM,
D. Gear.
World Water, Vol 5, No 2, p 33-35, 37, February, 1982. 2 Fig.

Descriptors: *Water resources development, *Wells, Water supply, Drinking water, Africa, Irrigation, Water demand.

In African countries, hard rocks cannot usually be exploited economically for crop irrigation by tubewells due to the fact that their yield is too low to help solve water problems. Surface water irrigation is restricted to infrequent local combinations of favorable circumstances. Groundwater, however, can be economically exploited by the use of the most appropriate package of techniques. Crop irrigation using hard rock groundwaters would ideally be performed in separate family operated units, each averaging about one hectare. The shape, dimensions and orientation of the traditional Indian storage well, under the right conditions, enable it to draw upon a much larger volume of slowly permeable rock than does a tubewell, and allows a greater chance of intersecting a number of the more permeable collecting zones within the rock. Another advantage of the Indian storage well is that beyond a certain number of people served, it will usually provide drinking water at a lower cost than tubewells. A variation of the Persian wheel powered by draught animals, might be the most suitable water drawing device. Basin irrigation would probably be used, it is still a good method for unsophisticated conditions, but not the only one. Associated catchment, farm, land-use and water conservation practices are needed for a variety of reasons, including the extension of the period of water availability during adverse climatic conditions and the reduction of soil and timber fuel losses. (Baker-FRC)
W82-05503

THE APPLICABILITY OF LARGE-DIAMETER, SHALLOW WELLS TO A COASTAL PLAIN HYDROGEOLOGIC ENVIRONMENT, GEORGIA,
Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.
B. F. Beck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236621, Price codes: A03 in paper copy, A01 in microfiche. Report ERC 03-81, November, 1981. 37 p, 13 Fig, 4 Tab, 20 Ref. OWRT A-085-GA(1).

Descriptors: *Shallow wells, *Irrigation wells, *Coastal plains, *Stratigraphy, *Hydrologic as-

pects, Well water, Drilling, Water supply development, Sediments, Coastal aquifers, Hydraulic permeability, Theoretical analysis, field tests, On-site tests, Groundwater, Water quality, Economic aspects, Hydrologic system.

Research was conducted to determine the success of large-diameter shallow wells based on field evaluation of currently-used irrigation pits and a detailed examination of the area stratigraphy. Such wells may prove economically advantageous over deeper wells in the Georgia coastal plains. It was found that shallow Pleistocene coastal plain sediments form a series of alternating bands of lagoonal and barrier island facies deposits laid down by a prograding shoreline, and that the two facies have distinctly different hydrologic characteristics and cannot be treated as a single shallow aquifer. The Clayey lagoonal sediments are impermeable for practical use; the sandy barrier island sediments are highly permeable. Narrow bands of the island sediments are good aquifers. Field tests of two irrigation pits and theoretical predictions indicate that large-diameter shallow wells (irrigation pits) should provide sustained yields of at least 4 up to 20 gallons/minute in older Miocene sediments at the surface inland of the Pleistocene shoreline complex, while island sediments should yield over 100,000 gallons/day. Water quality of the shallow sediments is good to excellent, with shallow wells having total dissolved solids of 100 ppm or less and undetectable bacterial contamination. Further, these wells may cost only 15% that of deeper sand wells or deep wells. (Zielinski-MAXIMA)
W82-05548

WATER YIELD ESTIMATION IN WESTERN UNITED STATES,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W82-05689

SOLUBLE MINERAL CONTENT IN SURFICIAL ALLUVIUM AND ASSOCIATED MANCOS SHALE,
Ben-Gurion Univ. of the Negev, Beer-Sheba (Israel). Dept. of Geography.
J. B. Laronne, and S. A. Schumm.
Water Resources Bulletin, Vol 18, No 1, p 27-35, February, 1982. 8 Fig, 3 Tab, 22 Ref. OWRT B-121-COLO.

Descriptors: Solute, *Alluvium, *Shales, *Minerals, *Salts, River basins, Sedimentation, *Salinity, *Upper Colorado River, Water pollution sources.

Most arid and semiarid regions experience problems resulting from high salt content in soils and from high solute concentrations in runoff. The rate of salt pickup under varying hydrologic conditions depends on net dissolution and sediment removal rates and on soluble mineral content and its spatial and temporal variations. The Mancos Shale terrain is a source of considerable solute contribution to the Colorado River. The spatial variability of soluble mineral content in weathered Mancos Shale and its associated alluvium was studied in an effort to understand the mechanism of salt production and to determine the source of salinity. Soluble mineral content was found to be highly variable in the alluvium and in associated surficial Mancos Shale. However, it was possible to identify lithomorphological units based on the soluble mineral content. Study results show that crusts are leached in deep alluvial fills, and that they have somewhat lower soluble mineral contents than underlying Mancos Shale on hillslopes. The crusts were found to be saline, sometimes efflorescent, in shale bedrock channels or where channels abut against the shale. Soluble mineral content increases in alluvium with decrease in depth of alluvial fill, does not vary significantly with depth in deep alluvial fills, and increases with depth in shallow fills. Soluble mineral content trends identified by this study can be used in the development of mathematical models and land management programs in areas of the Colorado River basin experiencing salinity problems. (Carroll-FRC)
W82-05751

HOW PROPER PROSPECTING IMPROVES THE ODDS,
International Reference Center for the Community Water Supply, the Hague (Netherlands).
E. Hofkes, and L. Terwey.
World Water, Vol 5, No 3, p 41-43, March, 1982. 3 Fig.

Descriptors: *Groundwater mining, *Measuring instruments, *Resistivity, Electrical well logging, Groundwater availability, Groundwater movement, Groundwater potential, Well logs, Seismic refraction, Remote sensing, Tracers, Radioactive tracers.

Proper groundwater prospecting is important in providing water supplies in developing regions. After the objective is defined (local or regional supply), a systematic approach is used. First, all available hydrogeological data are studied. Then the study area should be surveyed, preferably toward the end of the dry season. Among the surface geophysical methods electrical resistivity and seismic refraction are suitable for prospecting in shallow formation. Equipment is readily available. Geophysical well logging provides data on the physical properties and characteristics of the formations, water quality, and proper well construction. Well logging may involve measurements of electric resistivity, spontaneous potential, and natural gamma radiation. Aerial methods are photography, multispectral and thermal infrared scanning, and side-looking radar. Radioisotopes (deuterium, 018, tritium, and C14) are used as tracers to study groundwater movement, residence time, recharging, and location. (Cassar-FRC)
W82-05757

FOREST MANAGEMENT FOR INCREASED WATER YIELD--HOW USEFUL IN SOUTHERN ALBERTA,
C. R. Neill.
Canadian Water Resources Journal, Vol 5, No 1, p 56-75, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Forest management, *Vegetation effects, *Water yield improvement, Small watersheds, Clearcutting, Alberta, Oldman River, Forest watersheds, Snowmelt, Chinook, Colorado, Land management, Flow augmentation, Watershed management, River basins, Seasonal variation.

Reducing forest cover to increase water yield in the Oldman River Basin, Alberta, would produce questionable benefits and possibly adverse effects on flow regulation and water quality. Data from international research on small basins indicate that clearcutting increases water yield from 5 to 50%, highest in warm humid regions. Thinning or selective cutting produces negligible effects. Yield gradually decreases with vegetation reestablishment and reforestation. In some regions such as Colorado the increased yield occurs almost entirely in the snowmelt period. It is unreliable to extrapolate results from one region to an untested region. Results from large basins and from Russia are less conclusive and sometimes contradictory. Although clearcutting in Colorado increased water yield by 18-31%, results from Alberta experiences in clearcutting were inconclusive. Estimates of water yield increases by manipulating 1300 sq km of forest at Lethbridge are 2% of natural average flow averaged over the life of the timber cycle and nonexistent during dry year sequences. (Cassar-FRC)
W82-05760

3C. Use Of Water Of Impaired Quality

WATER REUSE PLANNING BY MEANS OF AN INPUT-OUTPUT TABLE,
Swiss Reinsurance Co., Zurich.
For primary bibliographic entry see Field 6A.
W82-04794

COMPARISON OF COLIPHAGE AAD BACTERIAL AEROSOLS AT A WASTEWATER SPRAY IRRIGATION SITE,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
H. T. Bausum, S. A. Schaub, K. F. Kenyon, and M. J. Small.
Applied and Environmental Microbiology, Vol 43, No 1, p 28-38, 1982. 2 Fig, 9 Tab, 25 Ref.

Descriptors: *Wastewater irrigation, *Bacteria, *Aerosols, Irrigation, *Land application, Wastewater, Wastewater disposal, Coliforms, Viruses, Coliphage, Public health, Impaired water use.

Land application by spray irrigation has been suggested as an alternative to advance wastewater treatment. However, this procedure entails potential human health hazards due to pathogen-containing aerosols. Data were gathered at a golf course irrigated with secondary domestic wastewater effluent. Bacterial aerosols reached 500 bacteria per cubic meter at 152 meters downwind and 10,500 bacteria per cubic meter at 46 meters. Seeded coliphage f2 averaged 400,000 plaque-forming units per ml in the effluent and were detected 563 meters downwind. Downwind microbial aerosol levels were somewhat enhanced by night time conditions. The median aerodynamic particle size of the microbial aerosols was about 5.0 micrometers. Chlorination reduced wastewater bacterial levels 99.97% and reduced aerosol concentrations to near background levels. Coliphage f2 was reduced only 95.4% in the chlorinated effluent and was readily measured 137 meters downwind. Microbiological source strength and meteorological data were used in conjunction with a dispersion model to generate mathematical predictions of aerosol strength at various sampler locations. The mean calculated survival of aerosolized bacteria in the range 46 to 76 meters downwind was 5.2%, and that of coliphage f2 was 4.3%. (Baker-FRC)
W82-04830

ALFALFA HAY GROWN WITH MUNICIPAL WASTE WATER AND PUMP WATER,
Arizona Agricultural Experiment Station, Tucson.
A. D. Day, R. S. Swingle, T. C. Tucker, and C. B. Cluff.
Journal of Environmental Quality, Vol 11, No 1, p 23-24, 1982. 2 Tab, 11 Ref.

Descriptors: *Wastewater irrigation, *Municipal wastewater, Water reuse, Water conservation, Agriculture, *Alfalfa, Irrigation, Irrigation programs.

The objectives of this research were to compare the quality of a wastewater and pump water mixture with the quality of pump water alone as a source of irrigation water for alfalfa hay production and to compare the yield and quality of alfalfa hay irrigated with a mixture of wastewater and pump water with the yield and quality of alfalfa hay irrigated with pump water alone. The average water penetration into the soil was higher for the wastewater and pump water mixture than for pump water alone. Pump water contained more total soluble salts and nitrate-nitrogen but less total nitrogen and phosphorus than the wastewater and pump water mixture. The general quality of irrigation water was influenced by salt concentrations. High salt concentrations in irrigation water were detrimental to plant growth, as excessive salt levels inhibited germination, limited water uptake and caused specific toxic effects on plants due to ions present in the salts. The wastewater-pump water mixture was a higher quality irrigation source than pump water alone, and was superior for use in growing plants. More phosphorus was deposited on fields irrigated with the wastewater-pump water mixture than was added to fields irrigated with only pump water. This may explain the high levels of extractable phosphorus present in soils irrigated with the wastewater-pump water mixture than were found in soils that received pump water alone. Plants grown with the wastewater-pump water mixture were taller and produced more dry matter in both 1974 and 1975 than did plants irrigated with only pump water. (Baker-FRC)
W82-04873

CASEIN WHEY WASTEWATER EFFECTS ON SOIL PERMEABILITY,

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Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
K. W. McAuliffe, D. R. Scotter, A. N. Macgregor, and K. D. Earl.
Journal of Environmental Quality, Vol 11, No 1, p 31-34, January-March, 1982. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Wastewater disposal, *Land disposal, *Wastewater irrigation, Irrigation, *Dairy industry, Irrigation programs, Permeability coefficient, Permeability, Soils, Soil properties, Saturation, Pores.

Experiments are reported to show the changes in soil permeability induced by dairy plant effluent application and to elucidate the mechanisms responsible for the observed changes. Soil cores were collected from a Tokomaru silt loam, a Kopua silt loam and a Manawatu silt loam. A single application of simulated effluent reduced hydraulic conductivity by an average of 46% in the soils. In comparison, cores treated with only water exhibited negligible reduction in hydraulic conductivity. The incorporation of sodium azide (a microbial inhibitor) with the effluent minimized the decline in hydraulic conductivity. Cores that received repetitive effluent applications exhibited an average hydraulic conductivity decline of 99%, whereas cores that received repeated doses of effluent plus inhibitor showed a smaller reduction of 55%. Respirometry studies indicated that the sodium azide did not completely inhibit soil biological activity throughout the entire undisturbed core. It is suggested that the reduction in hydraulic conductivity may reflect a combination of physical and biological processes. Several practical implications were noted. To avoid reduction in saturated hydraulic conductivity an aerobic soil environment should be maintained; thus a land disposal site should never be overloaded so that ponding occurs. An interval between applications is needed to allow hydraulic conductivity recovery. Pore blockage would be lessened, but not eliminated, if suspended solids were removed from the effluent prior to irrigation. (Baker-FRC)
W82-04874

THE OCCURRENCE OF FLOW CHANNELS IN SOILS,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
T. W. Simpson, and R. L. Cunningham.
Journal of Environmental Quality, Vol 11, No 1, p 29-30, January-March, 1982. 1 Fig, 6 Ref.

Descriptors: *Groundwater pollution, *Wastewater irrigation, Channels, Topography, *Water reuse, Saturated flow, Saturation, Water pollution, Soil types, Wastewater disposal.

Investigations were conducted at the Pennsylvania State University Wastewater Irrigation Site which identified soil water flow features described as channels. The site under study has been used as a wastewater disposal area over a 14 year period. Plots received 0, 2.5, or 5 cm of irrigation per week. Some areas only received irrigation water during the growing season. Soil morphology changes were studied and related to changes in time and amounts of wastewater applied. Soil sample cores were also collected from selected horizons of some pits to determine saturated hydraulic conductivity associated with the observed channels. The channels were vertically oriented, variable in size from 50 to 2 cm in diameter, had inverted cone-shaped bodies that had a low bulk density, and were much less firm than the surrounding soil. Many large apparently continuous pores exist in soil material recognized as a channel. Channels usually start in the upper subsoil and extend into lower horizons. Channels range in depth from less than one centimeter to 60 cm. The presence of channels in non-irrigated control areas suggests that their existence may be a natural phenomenon. Channel formation is most likely related to internal erosion of the soil material along structural faces that are coincident with solution channels in the bedrock. Hydraulic conductivity results suggest that the conventional core method may reduce the measured conductivity of the channels. It is evident that the channels are important in water movement at the wastewater irrigation site. If they allow wastewater to leave the biologically active portion of the soil without adequate renovation, groundwater contamination is likely. (Baker-FRC)
W82-04875

DISTRIBUTION OF PHOSPHORUS IN SOILS IRRIGATED WITH MUNICIPAL WASTEWATER EFFLUENT: A 5-YEAR STUDY,
Minnesota Agricultural Experiment Station, St. Paul.
J. J. Latterell, R. H. Dowdy, C. E. Clapp, W. E. Larson, and D. R. Linden.
Journal of Environmental Quality, Vol 11, No 1, p 124-128, January-March, 1982. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Wastewater irrigation, *Phosphorus, Soil water, Groundwater, Water pollution sources, *Municipal wastewater, Land disposal, Phosphates, Phosphorus removal, *Water reuse.

The objectives of this study were to determine the distribution of various phorphous forms in soil irrigated for 5 years with municipal wastewater and to measure the phorphous-adsorption power of the soil after 5 years of phosphorous loading. The experiment site was adjacent to the Apple Valley, Minnesota wastewater treatment plant, an activated sludge plant with effluent polishing filters. The soil was Waukegan silt loam with a water table at about the 140 to 150 cm depth. Plots receiving comparable quantities of phosphates via wastewater and mineral fertilizer behaved in a similar manner. Plots receiving about two times the above phosphate loading lost some phosphate through leaching to the 60 cm depth. Phosphorus adsorption studies, using the Langmuir equation, showed that the adsorption power of soil in the high rate treatment had been reduced. This was substantiated by the higher phosphorus concentrations noted in soil water at the 60 cm depth in the high treatment areas. (Baker-FRC)
W82-04881

WATER TO THE SOUTH-WESTERN CAPE KEEPING UP WITH THE DEMAND.
Civil Engineering in South Africa, Vol 23, No 11, p 521, November, 1981.

Descriptors: *Water supply development, *Water demand, Water resources development, Water reuse, Rivers, Water desalination, Desalination, *Cape Town, *South Africa.

The demand for water in Cape Town and the South-Western Cape area has forced water planners to consider unconventional water sources, such as recycling or desalination of sea water. The current supply should be adequate until 1988. Only about six conventional sources of water of the South Western Cape remain to be tapped, most of them too small to make a difference. The development of the Cape Flats' groundwater potential is one of the more promising schemes although its potential is limited, with a yield of about 10 million cubic meters per annum. Diverting untapped water out ot the Eerste and Kuils Rivers to supplement the groundwater supply would add about 20 million cubic meters per annum. The Diep River could yield 11 million cubic meters per annum, but the water is brackish and unreliable. Rietvlei, which is fed by the Diep River, could also create an ecological problem if the river were to be dammed. Surplus water in the Berg River could still be tapped, yielding 10 million additional cubic meters per annum. The Lourens River source will yield 10 million cubic meters per annum, but will only be economically viable if done in conjunction with the Ralmiet River Project which would yield 33 million cubic meters per annum. If these sources are tapped and coupled with recycled water usage, the supply could be enlarged to sufficient proportions to meet demand into the end of this century. (Baker-FRC)
W82-04887

REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE,
Pennsylvania State Univ., Harrisburg. Dept. of Environmental Resources.
For primary bibliographic entry see Field 5E.
W82-05065

IRRIGATION OF CALIFORNIAGRASS WITH DOMESTIC SEWAGE EFFLUENT: WATER AND NITROGEN BUDGETS AND CROP PRODUCTIVITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
L. L. Handley, and P. C. Ekern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224585, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 141, December 1981. 29 p, 1 Fig, 8 Tab, 67 Ref, 1 Append. A-075-HI(1), 14-34-0001-9013, -0113.

Descriptors: *Effluent reuse, *Nitrogen cycle, Water budget, Biomass, Pastures, Hawaii, *Impaired water use, *Irrigation practices, *Crop production, Wastewater disposal, *Californiagrass, Nitrogen budget, Tropical grass cultivation, Paragrass, Mililani, Oahu.

Californiagrass (paragrass) irrigated with effluent from secondarily treated domestic sewage showed excellent response as a means for disposal of large amounts of water, effective removal of nitrogen, and high production of excellent fodder. This grass, already well established in Hawaii, is used for pasture and fodder, endures flooding, and because of its allelopathic habit forms dense, easily maintained monostands. The water, nitrogen, and biomass budgets of the grass over a 17-mo period, from April 1979 through August 1980, were measured in eight large percolate-style lysimeters filled with the Lahaina series soil (Tropeptic Haplustox). The experiment was conducted on the grounds of the Mililani Wastewater Treatment Plant in central Oahu, Hawaii. Under irrigation rates which reached as great as 98 mm/day 5 days a week, consumptive use of water by the grass averaged 4 mm/day and was linearly correlated with biomass production. The monthly effluent nitrogen content ranged from 17 to 59 mg/l. With effluent nitrogen application rates which ranged from 475 to 2 600 kg/ha/yr, an average 69% was harvested in the grass, 3% percolated, nearly 28% was denitrofied, while the soi nitrogen status remained unchanged or decreased slightly. Even with the highest effluent irrigation rates, nitrate nitrogen levels in the percolate remained less than the 10 mg/l recommended maximum for potable water. Crop productivity was linear with applied nitrogen. Dry weight averaged 150 tons/ha/yr, with a maximum short-term productivity equivalent to 193 tons/ha/yr. The calculated crude protein content with the highest nitrogen application rates was 13%, while the caloric value was 4 000 kcal/kg, and no nitrate nitrogen levels in the forage exceeded 0.1%.
W82-05153

ABANDONED COAL MINES IN WEST VIRGINIA AS SOURCES OF WATER SUPPLIES,
West Virginia Geological and Economic Survey, Morgantown.
P. Lessing, and W. A. Hobba, Jr.
West Virginia Geological Survey, Circular C-24, 1981. 18 p, 3 Fig, 1 Tab, 1 Append.

Descriptors: *Water supply, *Water use, *Coal mines, Mine drainage, Available water, *Water storage, Precipitation, Infiltration, Selective withdrawal, Wells, Water quality, Water treatment, *West Virginia, Appalachian Plateaus, *Abandoned coal mines.

West Virginia is underlain by numerous beds of coal, many of which have been mined out in places. These underground mines have subsequently been abandoned and are now flooded and/or drain continuously. At present, 72 public water systems supply 8 to 12 million gallons of water per day from abandoned or active mines to 81,600 people and various industrial and commercial establishments. Most of these systems are in southern West Virginia, where the coal contains few sulfur minerals to dissolve and create problems of acid, iron, and sulfate in water. From 5 to 6 inches of precipitation is potentially available annually to seep into underground mine reservoirs. The

amount of water stored in the mine, the rate of infiltration, and the rate of withdrawal determine how much water is available for use. If the water is pumped from a mine by a well, then care must be taken to locate the well in lower parts of the mine, where water tends to accumulate as the water level is lowered by pumping. Some communities using mine water only chlorinate the water, but generally more extensive treatment is required to increase the pH or remove excessive concentrations of hardness, iron, and sulfate. (USGS)
W82-05219

FORAGE PRODUCTION UTILIZING CHEESE PLANT EFFLUENT UNDER HIGH-ALTITUDE CONDITIONS,
Wyoming Univ., Laramie.
M. C. Greene, R. H. Delaney, J. L. Moyer, and J. Borrelli.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2855-2864, December, 1980. 4 Fig, 6 Tab, 23 Ref.

Descriptors: *Dairy industry, *Wastewater irrigation, *Nutrients, Effluents, Land application, *Forages, Grasses, Pasture management, Feeds, Irrigation, Nitrogen, Phosphorus, *Impaired water use, Plant growth, Livestock, Water pollution effects, Cold regions, Thayne, Wyoming, Fertilizers.

Effluent from the manufacture of Swiss and mozzarella cheeses was applied to forage plants in laboratory pots and under field conditions. Garrison creeping foxtail, smooth bromegrass, reed canarygrass, tall fescue, meadow bromegrass, alfalfa, and sainfoin were grown in pots under conditions similar to that of the cheese plant irrigation site at Thayne, Wyoming, where there is a 30-day frost free period. No growth inhibitors were present in the cheese plant effluent or a soluttion with the same N, P, and K concentrations (0.1, 0.3, and 61.0 mg per liter, respectively). Highest dry matter production was obtained with a control fertilizer solution with nutrient concentrations suitable for grasses (10.0 mg per liter N, 6.5 mg per liter P, 33.3 mg per liter K, and 45.0 mg per liter S). Most of the grass species watered with effluent contained less protein than the control. Legumes did not show this N deficiency. P content was higher in the effluent-watered plants. Digestibility was not affected by effluent. In general plants grown at 20/10C contained less dry matter, less protein, and less P than plants grown at 23/18C. In the field tests only four of 20 species survived the winter ice pack-- creeping foxtail, reed canarygrass, smooth bromegrass, and western wheatgrass. Creeping foxtail was superior to the others in digestibility and ash content and was well suited to the harsh growing conditions of the irrigation site. Nitrate levels in several species of grass approached levels potentially toxic to cattle, 0.32%. Soil N appeared to become stabilized at the site, but soil P levels increased, especially in the upper soil profile. (Cassar-FRC)
W82-05265

RAPID-INFILTRATION RESEARCH AT FLUSHING MEADOWS PROJECT, ARIZONA,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5D.
W82-05334

MANAGING SALINITY IN IRRIGATED AGRICULTURE,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 43-56, March, 1982. 6 Fig, 29 Ref.

Descriptors: *Irrigation efficiency, *Model studies, *Salinity, *Salt balance, Irrigation design, Irrigation practices, Irrigation-return flow, Hydrologic models, Simulation analysis, Optimization, Systems analysis, Groundwater management.

Salt balance is an important factor of any irrigated system. Structural measures to control salt levels in irrigation waters are effective but costly. Excessive accumulation of salts in groundwater and soils is often a problem in irrigated semiarid and subhumid agricultural areas. A non-structural management model is described which may aid in maintaining a permanent irrigated agricultural system at reasonable costs. An optimization model is used to distribute land and water resources, encourage conjunctive use of surface and groundwater, maintain salt movement out of the system, and keep the proper hydrologic balance. Simulation models are employed to assess the impact of agricultural activities on the saturated and unsaturated zones. The whole model operates on the concept that an irrigated system is made up of a number of components, each of which is vital to the smooth operation of the whole system. A simplified version of the model was applied to problems of salinity control in the Pauma, Pala, and Bonsall sub-basins of the San Luis Rey River Basin of Southern California. Model results suggest possible reductions in the normal rate of groundwater depletion by about 80%. (Geiger-FRC)
W82-05691

SEQUENTIAL WATER REUSE EFFECT ON STREAM SALINITY,
Colorado State Univ., Fort Collins. Engineering Research Center.
D. W. Hendricks, C. D. Turner, and D. Klooz.
Water Resources Bulletin, Vol 18, No 2, p 317-324, April, 1982. 6 Fig, 1 Tab, 3 Ref. OWRT A-051-COLO.

Descriptors: *Water reuse, *Salinity, *Irrigation, Water quality, South Platte River, *Colorado, Agriculture, Arid lands, Semiarid lands, Diversion, *Streamflow depletion, Flow regulation, Water storage.

A salinity model based on the water balance principle was developed to estimate the effects of sequential reuse of stream water on residual streamflow and salinity. The salinity increases and streamflow decreases caused by sequential water reuse in arid and semiarid western U.S. areas were shown in an application of the model to the South Platte River Basin, Colorado. The upper limit of total diversions based on minimum streamflow alone was 6,846,900 acre feet per year, which corresponded with an intolerable 5,000 to 10,000 mg per liter dissolved solids. Considering a tolerable salinity of 2600 mg per liter, the upper limit of total diversions was only 5,430,300 acre feet per year. If it was possible to capture an additional 300,00 acre feet per year of excess flow for reuse, 896,100 acre feet more water would be available. (Cassar-FRC)
W82-05731

LEACHING FRACTIONS AND SALT STATUS OF TWO IRRIGATED GYPSUM-RICH SOILS IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W82-05762

STRATEGIES FOR REUSE AND CONSERVATION,
Dames and Moore, Houston, TX.
B. P. Popkin.
Water/Engineering and Management, Vol 129, No 3, p 36 40-41, March, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Water conservation, *Water reuse, Conservation, Water supply, Nonstructural alternatives, Water demand, Economic aspects, Wastewater renovation, Pricing.

Technological and managerial strategies for municipal water conservation and reuse have been developed. Municipal water conservation and reuse strategies can reduce total and peak water consumptive use and redistribute water use demands. Such strategies can effect water, energy and waste utilities. Water conserving users may find that they incur a net cost burden by conserving and reusing, as service fees increase to offset inflation, expanded services and declining per capita water use. Water management plans and decisions are not based solely on economic analysis, but include many aspects such as multiple objectives, political considerations and historic imperatives. Structural water conservation and reuse strategies are those which consist primarily of the use of hardware and systems. Nonstructural water conservation and reuse strategies are those which consist primarily of software, policies and operations. Examples of devices used in structural water conservation strategies include lawn irrigation timers, swimming pool covers, low-flow shower heads, faucet aerators, toilet and pressure restrictors, and other specialty appliances. Examples of structural water reuse strategies include municipal wastewater and domestic grey-water reuse systems for yard irrigation, municipal wastewater recycling systems for all yard uses, and land application of municipal wastewater for irrigation of recreational facilities. Nonstructural water conservation strategies can incorporate water supply rationing, low minimum water use charges with increasing unit price rates for increasing total water use, seasonal water fees, and high charges and fines for excessive or selected water uses. Numerous economic approaches are useful in any review of water conservation and reuse strategies. (Baker-FRC)
W82-05790

THE WELLTON-MOHWAK DILEMMA,
Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W82-05883

IMPACT OF ENERGY DEVELOPMENT UPON WATER AND SALINITY IN THE UPPER COLORADO RIVER BASIN,
M. Flug, W. R. Walker, and G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 199-220, 1982. 8 Fig, 6 Tab, 25 Ref.

Descriptors: *Water resources development, *Mathematical models, *Energy sources, *Salinity, *Colorado River, *Water supply development, *Environmental effects, Water management, Resources management, Model studies, River basins, Policy making, Water policy, Cost analysis, Environmental policy, Available water.

The development and utilization of coal, oil, shale, uranium and energy in the upper Colorado River Basin will create large demands on the available water supply of the region and threaten the quantity and quality of downstream flow. A mathematical model based on a sub-basin analysis of available mineral and water resources was used to simulate the salt and water exchange phase of potential fuel conversion in the river basin. Potential energy developments are examined with respect to the resulting impacts upon both the salinity and quantity of the waters of Colorado River. A multilevel minimum cost of developing predetermined levels of energy output was used to generate model solutions. Results showed that water availability is the most critical factor affecting energy development in the Colorado River. Use of high salinity waters in development policies and interstate water transfers on the Upper Colorado River will allow a net reduction in salinity in waters at Lee Ferry, Arizona, of up to 20 milligrams/liter. (Geiger-FRC)
W82-05886

3D. Conservation In Domestic and Municipal Use

WATER SUPPLY IN THE USSR.
For primary bibliographic entry see Field 6D.
W82-04849

CONSERVATION ETHICS FOR THE 1980'S,
Black and Veatch, Dallas, TX.
H. J. Graeser.
Southwest and Texas Water Works Journal, Vol 63, No 10, p 8-10, 44, January, 1982.

Descriptors: *Water conservation, Legal aspects, Riparian rights, Water quality, *Irrigation, Water

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use, Consumptive use, Conservation, Water supply, *Municipal water, *Texas High Plains.

Recent studies by the High Plains Study Commission in Texas indicate that a 50% reduction in water use, from 1.38 acre feet per acre to 0.65 acre feet in 2020, would still necessitate a reduction in irrigated acreage in the Texas High Plains, from 6.1 million to 4.9 million acres. A shift to higher value, more water efficient crops would be necessary. In some states where water is abundant, problems occur over ownership of water rights. Facing the problem of interstate transfer of water rights and diminishing groundwater as well as international and interstate compacts affecting the quantity of surface water available from the Rio Grande River, the city of El Paso has attacked the problem of conservation. Homeowners have been encouraged to plant indigenous plants as opposed to high water consuming plants in their yards. Additional measures must be taken in the area of crops and farming to conserve needed water. Consideration is also given to the pricing of water on the basis of how it is used and how much is used. Public opinion must be brought into play to help in cutting down the wasteful application of water. Legal and financial procedures which will allow orderly reordering of water allocations with minimum economic and social penalties are needed. Above all a course of conservation must be taken which avoids consumptive use to the maximum extent and encourages augmentation of existing sources through re-use. (Baker-FRC)
W82-05009

DOMESTIC WATER CONSERVATION RESEARCH PLAN,
For primary bibliographic entry see Field 6B.
W82-05547

DROUGHT MANAGEMENT: EXPECTING THE UNEXPECTED,
Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.
V. Woo.
Journal of the American Water Works Association, Vol 74, No 3, p 126-131, March, 1982. 2 Fig, 19 Ref.

Descriptors: *Drought, Water management(applied), *Water supply, *Boston, Massachusetts, *San Francisco, California, Planning, Water shortage, Water conservation, Water demand, Water use, Urban areas, Risks.

Implementation of drought management plans in the San Francisco Bay area and in Boston, Massachusetts, produced large and long-lasting reductions in water consumption. In the 1976-77 San Francisco drought, both supply augmentation and demand reduction were used. Water (400,000 acre-feet) was reallocated from southern California to Marin County. The most dramatic reductions in demand occurred in Marin County. At the end of the drought in December 1977 consumers had reduced use there by 60% overall and by 75% among homeowners. Although the commercial and industrial sectors successfully met the requirements of mandatory conservation, they failed to accomplish goals under voluntary programs. A very successful method of promoting conservation was to establish a household water allotment but not dictate the particular use of the ration. As of 1980 water consumption in Marin County was still 22.5% below predought use, and in the East Bay Municipal Utility District, 86-100% of predrought use, without adjusting the figures for an 8.6% increase in connections. These changes in consumption have resulted in the adoption of risk management or incremental planning by some of the California water districts. Boston's 1962-66 drought caused minor economic losses, produced some new installations of long-term benefit, and pointed out idle capacity and inefficiencies. Although demand management appeared to be most suitable for water conservation planning, it was not the city's post-drought response. Instead, physical supply augmentation and incremental adjustments were chosen to supply water for future growth and drought emergencies during the next 10-20 years, considered a transitional period. (Cassar-FRC)
W82-05649

DROUGHT-RELATED WATER CONSERVATION EFFORTS IN MISSOURI,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
G. D. Reed.
Journal of the American Water Works Association, Vol 74, No 3, p 121-125, March, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Water conservation, *Drought, *Water shortage, Water supply, *Missouri, Water consumption, Water demand, Water use, Water management(Applied), Public relations.

During the drought of 1980 water suppliers to Missouri had to implement various water conservation policies with little time for planning. A review of literature on water conservation indicated that voluntary conservation schemes were successful only if accompanied by continous intensive public education and information programs. Pricing schemes, which produced greater use reductions than voluntary schemes, were effective only when the surcharge cost was significant and well-enforced. Answers to a questionnaire to which 31 of 52 Missouri water suppliers responded indicated that 24 suppliers had supply problems and attempted conservation measures. The most common reasons for initating conservation were limitations on treatment and storage facilities (42%) and inadequate raw water (29%). Voluntary conservation was used by 63% and mandatory bans on nonessental uses by 29% of respondents. Most of the failures occured in the voluntary programs. The methods of informing customers of the conservation measures were not as important as the enforcement procedures. None used a water bill surcharge. Seven supliers threatened to disconnect service in case of violation, and none experienced failures in their programs. Eighteen (75%) of suppliers reported successful conservation programs. Most difficulties were experienced by the public water supply districts. The keyto successful conservation programs appeared to be strict enforcement. (Cassar-FRC)
W82-05672

EFFECTS OF POTENTIAL WATER CONSERVATION EFFORTS IN EAST TENNESSEE,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
C. S. Bishop, G. T. Broach, W. H. Hester, and V. A. Sikora.
Water Resources Bulletin, Vol 18, No 2, p 189-196, April, 1982. 5 Tab, 15 Ref.

Descriptors: *Water conservation, *Water policy, *Water management, Water use, French-Broad River Basin, Tennessee, Regulations, National Water Policy, Social impact, Economic impact, Institutional constraints, Water supply, Water rates, Wastewater treatment.

The National Water Policy, established during the Carter administration, stressed water conservation on a national scale. The possible positive and negative effects of 10% voluntary reduction and 30% regulated reduction of water usage in the water-rich French-Broad River basin, Tennessee, are described. The two-county basin has abundant rainfall, small-scale agriculture, towns, and industry. With no water conservation in the basin there would probably be no significant environmental, socioeconomic, or institutional changes in the near future. A 10% voluntary reduction would be practical and achievable without producing significant impact on regional economic stability, water rates, or per capita consumption. Possible benefits are improved efficiency and delayed expansion for municipal wastewater treatment plants and improvements in efficiency and life of individual sewage disposal systems. A compulsory 30% water use reduction would be deleterious to social, economic, and political environments. Small marginal industries would close, cutting income of the residents and producing hostility to the plan. Water prices would rise dramatically to compensate for reduced municipal revenues. The local residents are opposed to housing and building codes and other regulations. Before a national conservation policy is implemented further studies must determine regional differences in cultural, social, economic, and institutional factors. (Cassar-FRC)
W82-05745

MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,
Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Resources Bulletin, Vol 18, No 2, p 271-277, April, 1982. 3 Tab, 19 Ref.

Descriptors: *Water conservation, *Elasticity of demand, Water use, Water policy, Municipal water, Industrial development, Economic development, Water rates, Domestic water, Arid lands.

The results of this study cast doubt on the widely believed assumption that municipal water supply restrictions and/or conservation policies affect urban growth, at least in western states. A water reduction of 25% would have little effect and would not likely inhibit growth because both household and industrial water demands are quite flexible. Present water use practices are generally wasteful. Water costs in industry are usually a small fraction (on the order of 1%) of total production costs. Neither water quantities nor water prices are likely to deter industries from locating in Western cities. However, cutting water use by 50% or more might discourage persons from moving to Western locations. Hence, there is little reason to oppose moderate water restrictions in fear of inhibiting urban growth or to favor such restrictions in hope of constraining growth. (Cassar-FRC)
W82-05748

WATER MANAGEMENT IN THE METROPOLITAN TORONTO REGION,
Metropolitan Toronto and Region Conservation Authority, Downsview (Ontario). Water Resource Division.
For primary bibliographic entry see Field 6B.
W82-05775

CURRENT TRENDS IN COST OF SERVICE STUDIES,
Coffin and Richardson, Boston, MA.
For primary bibliographic entry see Field 6C.
W82-05806

3E. Conservation In Industry

INDUSTRY HELPS CONSERVE MUNICIPAL WATER,
Anderson-Nichols and Co., Inc., Providence, RI.
P. R. Levine.
Journal of the American Water Works Association, Vol 74, No 3, p 132-135, March, 1982. 6 Fig.

Descriptors: *Water conservation, *Industrial water, *Water supply, New England, Attleboro, Massachusetts, Fracture permeability, *Groundwater availability, Municipal water, Wells, Groundwater mining, Groundwater sources.

Recent droughts caused the Attleboro, Massachusetts, reservoir to drop far below capacity. An industrial user, which consumed 25% of the city's supply, initiated water conservation measures and searched for alternate supplies. Two measures, employee education and recycling of process and cooling water, reduced use from 2 mgd to 0.85 mgd. No sand or gravel aquifers were found on the site. However, additional groundwater sources were located in fractured regions of bedrock by a new technique, fracture-trace mapping. Aerial photography located these places, which occur throughout New England in lengths of a few hundred feet to several miles. Four wells safely yielded 1 mgd of water if 8 hours rest period was allowed every 4 days. Currently, the manufacturer draws on the municipal water supply only for its potable water needs. (Cassar-FRC)
W82-05674

3F. Conservation In Agriculture

ALFALFA HAY GROWN WITH MUNICIPAL WASTE WATER AND PUMP WATER,
Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 3C.
W82-04873

THE 1977 DROUGHT IN IDAHO: ECONOMIC IMPACTS AND THE RESPONSES OF IRRIGATORS AND WATER DELIVERY ORGANIZATIONS.
Idaho water and Energy Resources Research Inst., Moscow.
J. R. Hamilton, D. J. Walker, and D. L. Grant.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220658, Price codes: A11 in paper copy, A01 in microfiche. Research Technical Completion Report, May 1981, 238 p, 4 Fig, 64 Tab, 115 Ref. OWRT B-246-IDA(1).

Descriptors: *Drought, *Cropping patterns, *Irrigation practices, Water management, *Crop production, *Idaho, Institutional constraints, Water shortage, Water law, Economic impact.

Survey methods were used in Idaho to document changes in cropping patterns, irrigation systems, and water management strategies caused by the 1977 drought; to document the way management strategies caused by the 1977 drought; to document the way insitutuions such as water delivery organizations and goverment agencies respond to drought; to measure the economic consequences of drought in southern Idaho; to draw implications regarding probable farmer response in future droughts; and to make suggestions for drought management strategies. While some farmers changed crops and varieties or idled land in anticipation of water shortage, the majority proceeded with normal cropping patterns. When water shortage occurred, the result was reduced yield, or in some cases complete loss of the crop. These yield declines and lost crops comprised the largest part of the economic impact of the drought.
W82-04959

RESTRUCTURATION OF THE WATER TARIFF SYSTEM FOR IRRIGATION DISTRICTS IN MEXICO.
Secretaria de Agricultura y Recurosos Hidraulicos, Mexico City.
For primary bibliographic entry see Field 6C.
W82-04962

CONSERVATION ETHICS FOR THE 1980'S,
Black and Veatch, Dallas, TX.
For primary bibliographic entry see Field 3D.
W82-05009

LATERAL MOVE IRRIGATION OFFERS ADVANTAGES FOR RECTANGULAR FIELDS.
World Farming, Vol 24, No 1, p 8, 26, 34-35, January/February, 1982.

Descriptors: *Irrigation engineering, *Automation, Linear irrigation, Canals, Farm equipment, Irrigation canals, Mechanical equipment, *Irrigation efficiency, Waker conservation.

The lateral move irrigation system offers many advantages not available in other irrigation systems, especially for large rectangular fields, Uniformity of water distribution increases crop yield by eliminating overwatered and underwatered areas. Fertilizer can be applied through the irrigation system. The linear system irrigates a field twice as fast as surface irrigation and uses 10-60% less water. Heavy, tight soils can be efficiently irrigated by this method bwcause of the low application rates, small droplet size, and low water pressure. The 3 types of linear irrigation systems are based on different types of water pickup. The canal or ditch method, most suitable for level fields, draws water from a canal located at either end or the center of a field. The hose system, useful on sloping fields, uses a high pressure hose, dragged along as the apparatus moves. An underground mainline pipe supplies water through evenly spaced hydrants, to which the system automatically couples and uncouples. Many variations in design are available to suit individual conditions. In addition to the different types of water pickup, there are a variety of nozzles and guidance systems, engines from 45 to 225 horsepower, and pumps from 1600 to 13,300 liters per minute. (Cassar-FRC)
W82-05080

CUTTING IRRIGATION COSTS,
J. E. Bowen, and B. A. Kratky.
World Farming, Vol 24, No 1, p 14-15, 18-19, 28-29, January/February, 1982. 1 Tab.

Descriptors: *Irrigation efficiency, *Costs, *Pumps, Energy, Surge irrigation, Surface irrigation, Return flow, Water reuse, Maintenance, *Water conservation.

Increasing energy and water costs have forced reevaluation of irrigation practices. Suggestions for saving irrigation costs include: avoid over-irrigation, optimize timing of water application, substitute low-pressure nozzles for high-pressure ones, modify tillage and management practices to reduce runoff, use gravity flow where possible, improve pump efficiency through preventive maintenance, use a return flow system, convert from sprinklers to a surface system, and try the surge flow technique. Windpower can be an alternate energy source for operating hydraulic rams. (Cassar-FRC)
W82-05081

WATER MANAGEMENT OF WHEAT IN HEAVY CLAY SOILS OF MADHYA PRADESH,
Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 2I.
W82-05119

EFFECT OF MOISTURE LEVELS IN VEGETATIVE AND REPRODUCTIVE PHASES OF WINTER-SOWN MAIZE ON GRAIN YIELD, IRRIGATION REQUIREMENT AND WATER-USE EFFICIENCY,
Rajendra Agricultural Univ., Samastipur (India).
For primary bibliographic entry see Field 2I.
W82-05120

FLEXCROP: A DRYLAND CROPPING SYSTEMS MODEL,
Science and Education Administration, Sidney, MT.
A. D. Halvorson, and P. O. Kresge.
Production Research Report Number 180, April 1982. 49 p, 9 Fig, 10 Tab, 51 Ref, 4 Append.

Descriptors: *Crop production, *Computer models, *Fallowing, *Grain crops, *Soil water, Saline seep, Deep percolation, Soil erosion, *Water use efficiency, Available water, Irrigation practices, *Northern Great Plains.

Wind and water erosion problems along with the development of saline seep areas in the northern Great Plains have made the crop-fallow system of farming undesirable as a farm management practice. Production of small grain or oilseed crops more often than every other year on soils affected by saline seep would reduce the loss of water during fallow by deep percolation, reduce saline seepage, and increase water-use efficiency. A flexible cropping system should consider the amount of plant-available soil water at seeding time; estimated average growing season precipitation; and grower management factors. Summer fallowing should be done only when water is so deficient that the probability of producing a profitable crop is low. A dryland cropping system computer model, 'FLEXCROP', was developed to help farm managers evaluate the effects of their crop and soil management decisions on potential crop yield and to help them decide whether to recrop or summer fallow a given field. Winter wheat, spring wheat, barley, oats, and safflower are the crops covered in the current model. (Moore-SRC)
W82-05208

REFLECTIONS OF THE CHOICE OF SOME PRIORITY AXES OF HYDRAULIC RESEARCH IN THE FIELD OF LAND AND WATER MANAGEMENT,
Rural Department for Waters and Forestry, Paris (France).
For primary bibliographic entry see Field 4B.
W82-05278

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH-FREQUENCY IRRIGATION, VOL 2: RESPONSE OF PEANUTS TO IRRIGATION MANAGEMENT AT DIFFERENT CROP GROWTH STAGES,
Texas A and M Univ., College Station. Water Resources Inst.
T. A. Howell, M. J. McFarland, D. L. Reddell, K. W. Brown, and R. J. Newton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224874, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 113, Vol 2, December 1980. 94 p, 29 Fig, 20 Tab, 25 Ref, 2 Append. OWRT B-219-TEX(2), 14-34-001-8121.

Descriptors: *Peanuts, *Irrigation practices, *Crop yield, *Evapotranspiration potential, *Growth stages, Irrigation, Plant growth, Irrigation efficiency, Irrigation effects, Irrigation operation, Water requirements, Evapotranspiration, Irrigation requirements, Agricultural hydrology, Assessments, Irrigation water, Transpiration.

A study was conducted to determine the optimum irrigation schedule for peanuts at different crop growth stages, using two peanut varieties (Spanish and Florunner) evaluated under seven different irrigation treatments. The treatments included a no-stress check treatment and a dryland treatment. Each treatment had a different schedule of either irrigating or stressing the peanut plant during one or more of three crop growth stages. For the Spanish variety: providing irrigation only during the pegging stage produced 394 kg/ha higher yield than irrigating during the early maturation stage; pegging stage irrigation treatments had an evapotranspiration amount at least 25 mm greater than treatments with no irrigation at this stage. For the Florunner variety: treatments which had an irrigation during the late maturation stage produced near maximum yield even though some treatments had a drought period; treatments having an irrigation during this stage had a steady evapotranspiration rate. The effects of other treatment schedules at other growth stages are also discussed. Recommendations for futher studies are provided. (Zielinski-MAXIMA)
W82-05293

A REPORT ON: RESEARCH NEEDS....WATER CONSERVATION IN AGRICULTURE,
E. A. Hiler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224833, Price codes: A03 in paper copy, A01 in microfiche. Report, July 1978. 29 p, 10 Ref. (No 8542)(1).

Descriptors: *Water conservation, *Water supply development, *Irrigation efficiency, *Research priorities, *Systems analysis, Assessments, *Agriculture, Water requirements, Irrigation requirements, Water storage, Water conveyance, Water management, Irrigation programs, Irrigation practices, Water control, Farms, Groundwater recharge, Optimization.

Current situations in various areas of two major categories related to water conservation in agricultural operations are assessed, with generally 3-6 critical themes identified in each area where research is most needed. The first major category (water source augmentations and improvements in off-farm delivery systems) addresses six water conservation areas (storage and conveyance; groundwater replenishment; improved water control and measurement structures; soil water; increasing and

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regulating streamflow; sediment reduction; improving economic and institutional arrangements). The second major category (improved on-farm water management related to irrigation scheduling and efficient systems) addresses three water conservation areas (irrigation water use efficiency; salinity control/management efficiency; optimizing crop water use). It is pointed out that isolated problem-solving can effect a slight change that may cause undue stress elsewhere in the entire system. Systems analysis is proposed as a means for viewing the entire water management problem. Specific research needs in systems analysis and a generalized approach for its use are also included. (Zielinski-MAXIMA)
W82-05308

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH-FREQUENCY IRRIGATION, VOL. 3: DETERMINING THE TRANSPIRATION RATE OF PEACH TREES UNDER TWO TRICKLE IRRIGATION REGIMES,
Texas A and M Univ., College Station.
T. A. Howell, M. J. McFarland, D. L. Reddell, K. W. Brown, and R. J. Newton.
Available from the National Technical Information Service, Springfield, VA 22161 as Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 113, Vol 3, December, 1980. 56 p, 8 Fig, 7 Tab, 19 Ref, 1 Append. OWRT B-219-TEX, 14-34-001-8121.

Descriptors: *Transpiration, *Evapotranspiration potential, *Trickle irrigation, *Peaches, *Irrigation efficiency, Evapotranspiration, Soil moisture retention, Rainfall rate, Irrigation effects, Irrigation operation, Irrigation practices, Irrigation requirements, Nutrient requirements, Water requirements, Crop yield, Plant growth, Trees, Water conveyance, Agricultural hydrology, Hydrologic aspects, *Texas.

Research was carried out to quantitatively determine the transpiration rate of two trickle irrigation treatments in a northcentral Texas peach orchard. A soil water balance method was used to determine evapotranspiration (ET). One treatment (II) irrigated at a calculated rate (the measured pan evaporation, times the surface area inside the tree drip line, multiplied by a replenishment factor of 0.6) through two emitters; the other treatment (I) received half the calculated rate, distributed through one emitter. Treatment II may have had a more extensive root distribution than I, as indicated by observed moisture extraction patterns. The tree in each treatment could obtain moisture stored in the root zone. Both treatments had an ET rate considerably greater than their irrigation rates. However, the ET rates of both treatments were below the potential ET. Estimates of the transpiration rates of treatments I and II were 1.6 and 3.5 mm/day, respectively. Determinations of ET were based upon determinations of the change in soil moisture, and the levels of rainfall and irrigation. Recommendations of future research and design criteria areas based on the results of these studies are delineated. (Zielinski-MAXIMA)
W82-05312

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH FREQUENCY IRRIGATION,
Texas A and M Univ., College Station.
T. A. Howell, K. W. Brown, R. J. Newton, D. L. Reddell, and M. J. McFarland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224866, Price codes: A02 in paper copy, A01 in microfiche. Summary Report for Technical Report No 113, March 1981. 12 p, 1 Fig, 3 Tab, 2 Ref. OWRT B-219-TEX, 14-34-0001-8121.

Descriptors: *Irrigation efficiency, *Irrigation practices, *Nutrient requirements, *Crop yield, *Plant growth, Irrigation effects, Irrigation operation, Irrigation requirements, Sprinkler irrigation, Trickle irrigation, Peanuts, Peaches, Trees, Water requirements, Water conveyance, Water supply, Soil moisture retention, Agricultural hydrology, Hydrologic aspects, Nitrates, Water allocation, Water conservation, Sorghum, *Texas.

Research was directed toward defing the best management practices for irrigation timing and fertilizer applications under high frequency irrigation. Following a comparison of methods for determining soil hydraulic properties (Vol. I), research was conducted on a comparison of peanut water use efficiencies under differing sprinkler irrigation regimes (Vol. II), on an evaluation of water requirements by peach trees under trickle irrigation (Vol. III), and on a determination of nutrient and water requirements relative to grain sorghum response (Vol. IV). Irrigation water was pumped from the Brazos River into a lined pond, filtered, and pumped by turbines for the trickle system and for sprinkler, micro-basin, and furrow plots. An automatic weather station monitored climatic conditions, and soil samples were routinely analyzed for nitrogen content. The research results demonstrated high frequency irrigation to be a proven management system with several advantages. It has the potential for significantly increasing crop yield by application of a relatively small percentage of the total water requirement. The rainfall regime must, however, be favorable for the value of high frequency irrigation studies to be quantifiable. (Zielinski-MAXIMA)
W82-05313

SOIL WATER INTAKE RATES AND SURFACE IRRIGATION SYSTEM CHARACTERISTICS BY SOIL SERIES IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236548, Price codes: A05 in paper copy, A01 in microfiche. Report, March, 1981. 84 p, 4 Fig, 7 Tab, 12 Ref, 4 Append. OWRT B-041-IDA(3).

Descriptors: *Soil water, *Soil types, *Intakes, *Surface irrigation, *Irrigation practices soil water potential, Loam, Soil texture, Hygroscopic water, Agricultural runoff, Experimental design, Agricultural hydrology, Soil conservation, Crop yield, Field capacity, Testing procedures, Field tests.

Seven major soil series of irrigated agricultural land in southeastern Idaho, ranging from silt loam to gravelly loam in texture, were evaluated to obtain soil water intake rates. Three crops (hay, grain, and poatoes) were selected for the study, and soil survey maps from the local Soil Conservation Service were used to locate each area soil series. Since it was difficult to select representative sampling sites in a given field, it was necessary to test several different sites to obtain average results. Irrigation practices evaluated on two furrow fields from data obtained in the study revealed that improved water management practices are needed on both fields to obtain higher application efficiencies. One field had excess irrigation with high runoff loss; the other had a lack of irrigation with high runoff loss. Application efficiency could be increased by using a cut-back stream and/or a return flow recovery system. To assess border irrigated fields the infiltrometer ring test (RT) was used; for furrow fields, the inflow-outflow (IO) method was used. Potato fields generally had lower intake rates than other crops by the RT method. Intake rates for furrow-irrigated potato fields differed between those obtained by the RT and those obtained by the IO method. While the IO method has been known as the most dependable for obtaining intake rates, under some conditions the RT is a simpler and easier method. (Zielinski-MAXIMA)
W82-05539

OPTIMIZING THE USE OF WATER AND NITROGEN THROUGH BREEDING OF CROPS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Fischer.
Plant and Soil, Vol 58, No 1-3, p 249-278, 1981. 9 Fig, 3 Tab, 55 Ref.

Descriptors: *Crop production, *Water use efficiency, *Crop yield, *Water stress, *Nitrogen, Transpiration, Wheat, Barley, Arid zones, Soil-water-plant relationships, Water uptake, Plant growth, Drought resistance.

Breeding of special wheat and barley cultivars has increased crop yield in certain Mediterranean type environments over the past 20 years. The black box approach to drought resistance examines the yield differences of crops in terms of underlying process differences. Dwarfing of wheats has significantly increased their yield in arid regions. The ideotype approach to drought resistance and trait formulation, based on field measurements, is described. Encompassed in this approach are the effects of water limitation, crop transpiration, and the maximization of the harvest index. Optimal flowering date strategies, preanthesis water stress, and hot spell damage are also discussed. Ideotype testing is often limited by lack of rapid screening methods. The impoved nitrogen utilization efficiency of higher yielding cultivars is related to more grain per unit of nitrogen taken up by the crop rather than to more nitrogen uptake. Genotype selection may help overcome water stress injury due to high plant nitrogen content. (Geiger-FRC)
W82-05608

OPTIMIZING THE USE OF WATER AND NITROGEN THROUGH SOIL AND CROP MANAGEMENT,
Oregon State Univ., Corvallis. Dept. of Crop Science.
F. E. Bolton.
Plant and Soil, Vol 58, No 1-3, p 231-247, 1981. 4 Fig, 3 Tab, 34 Ref.

Descriptors: *Crop production, *Water use efficiency, *Soil management, *Nitrogen, Soil water, Arid zones, Fertilizers, Water use, Weed control, Water storage, Transpiration, Soil-water-plant relationships, Planting management.

Under rainfed production of crops, water must be used efficiently to optimize water and nitrogen supplies. To accomplish this, maximum amounts of water can be stored in the soil profile by improved tillage and moisture conservation practices while maximum use is made of stored water through improved crop management practices. In semi-arid, rainfed regions, fertilizer applications should be based on current moisture supplies rather than long-term averages. The 'package of practices' approach involves utilizing the best combinations of tillage, selection of adapted varieties and optimum planting and fertilizer application times, and weed control and harvesting techniques. The proper package of practices must be determined in extensive field studies conducted over a long period of time. Each element in the production package must be performed in the proper sequence or to the advantage of the other elements. Since many resources such as fertilizers and herbicides are not presently available in the developing countries, implementation of the complete production package in these nations is not yet feasible. Use of some elements of the production package which fit into the traditional system may offer substantial increases in yield until other elements of the production package are applied at a later date. (Geiger-FRC)
W82-05609

PLANT IMPROVEMENT FOR SEMI-ARID RANGELANDS: POSSIBILITIES FOR DROUGHT RESISTANCE AND NITROGEN FIXATION,
Utah State Univ., Logan. Crops Research Lab.
D. A. Johnson, M. D. Rumbaugh, and K. H. Asay.
Plant and Soil, Vol 58, No 1-3, p 279-303, 1981. 3 Fig, 98 Ref.

Descriptors: *Range management, *Semiarid lands, *Grazing, *Drought resistance, *Vegetation regrowth, Range grasses, Water stress, Water deficit, Drought, Nitrogen, Legumes.

As world population increases, so should the importance of semi-arid rangeland for off-season livestock grazing in rotation with croplands. Improved plant materials and better grazing management practices are needed to rectify problems caused by underproduction due to overgrazing. The development of drought-resistant range plants is being studied through drought characterization, defini-

tion of selection criteria, assemblage of a broad genetic base, and the development and application of screening methods. Since plant productivity on many arid rangelands is limited by nitrogen, legumes should be evaluated to assess their potential for contributing nitrogen to the rangeland environment. Interdisciplinary programs should be tested to bring about plant improvement under drought stress to develop cultivars suitable for the re-vegetation of semi-arid rangelands. (Geiger-FRC)
W82-05610

CABLEGATION: I. CABLE CONTROLLED PLUGS IN PERFORATED SUPPLY PIPES FOR AUTOMATIC FURROW IRRIGATION,
Science and Education Administration, Kimberly, ID.
For primary bibliographic entry see Field 8A.
W82-05617

EROSION CONTROL POTENTIAL WITH CONSERVATION TILLAGE IN THE LAKE ERIE BASIN: ESTIMATES USING THE UNIVERSAL SOIL LOSS EQUATION AND THE LAND RESOURCE INFORMATION SYSTEM (LRIS),
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 4D.
W82-05661

POTENTIAL FOR GROUNDWATER RECHARGE SEEPAGE FROM FLOOD-RETARDING RESERVOIRS IN SOUTH CENTRAL NEBRASKA,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W82-05663

ADVANCE AND RUNOFF-SURGE FLOW FURROW IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
P. S. Coolidge, W. R. Walker, and A. A. Bishop.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 35-42, March, 1982. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Furrow drainage, *Irrigation efficiency, *Irrigation design, *Irrigation requirements, Furrow irrigation, Furrows, Surges, Irrigation ditches, Irrigation return flow, Irrigation practices, Irrigation engineering, Irrigation water, Water conservation.

Furrow advance and runoff studies were conducted on a field of silt loam soil using pulsed water applications. The surge flow irrigation method, defined as the intermittent application of water to furrows or borders creating a series of on and off modes of constant or variable time spans, was applied in two experiments each covering 100 m furrow sections. The first experiment tested 13 combinations of on-and off-times, each replicated 5 times. The second investigation consisted of 10 combinations of cycle period and cycle ratio with two replications. Results showed that the application of surge flow irrigation significantly accelerated furrow advance per unit of water used while reducing the temporal and spatial variability among furrows in the field. It was suggested that furrow drainage between surges accelerated the formation of thin surface seals, thereby reducing intake rates. (Geiger-FRC)
W82-05690

MANAGING SALINITY IN IRRIGATED AGRICULTURE,
Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W82-05691

NEW EVAPOTRANSPIRATION CROP COEFFICIENTS,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
J. L. Wright.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 57-74, March, 1982. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Mathematical studies, *Evapotranspiration, *Irrigation requirements, *Irrigation efficiency, *Model studies, Evaporation, Evapotranspiration potential, Irrigation programs, Irrigation water, Mathematical models, Crop production, Transpiration.

New crop coefficients for the Pacific Northwest irrigated crops of alfalfa, potatoes, snap beans, sugar beets, sweet and field corn, garden peas, winter and spring wheat, and spring barley were developed for use in the relationship describing evapotranspiration (ET). Reference ET was based on the ET rate for well watered, actively growing alfalfa in arid, irrigated regions. The improved ET coefficients represent basal or minimal coefficients reflecting conditions of minimal soil evaporation, but adequate root zone moisture. They can be used with the United Stated Department of Agriculture Computerized Irrigation Scheduling Program for estimating daily crop ET. When combined with improved estimates of evaporation from wet soils, the new coefficients should permit more accurate estimates of daily crop ET, and irrigation water requirements and thus more accurate irrigation scheduling. New crop models are needed to permit partitioning soil evaporation and plant transpiration, and to provide a basis for directly relating the crop coefficient to crop development. (Geiger-FRC)
W82-05692

OPTIMUM DEPTH AND SPACING OF SUBSURFACE DRAINS,
Marathwada Agricultural Univ., Parbhani (India).
For primary bibliographic entry see Field 8B.
W82-05693

A PREDICTION EQUATION FOR DAY NIGHT WIND RATIO CORRECTION ON REFERENCE CROP EVAPOTRANSPIRATION,
Marathwada Agricultural Univ., Parbhani (India).
For primary bibliographic entry see Field 2D.
W82-05722

IRRIGATION EFFICIENCY IN ORCHARDS,
Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Water Resources Journal, Vol 5, No 3, p 102-110, 1980. 4 Tab, 1 Ref.

Descriptors: *Irrigation efficiency, *Orchards, *Fertilizers, Apples, Water use, Summerland, *British Columbia, Fruit crops, Water conservation, Irrigation techniques, Lysimeters, *Canada.

The term irrigation efficiency encompasses four interrelated factors: efficiency of water use, efficiency of labor, efficiency of dollars, and efficiency of land. Orchardists in British Columbia's arid Okanagan Valley traditionally overirrigate, wasting 50% of the water applied, losing fertilizer, and changing soil chemistry. Possible solutions to this are increased capacity of the irrigation system so that irrigation can be done quickly and less frequently and conversion from sprinklers to trickle irrigation. In the Summerland District 12 lysimeters planted with McIntosh apple trees were used to study irrigation efficiency and fertilizer application. Application rates were equivalent to 3.6 mm per day (37% of usual irrigation allotment) in 1974-77; 4.6 mm per day in 1978-79. In these 6 years very little drainage was obtained from silt soils. Drainage from sandy loam soils was 13-38% of total applied water on bare ground and 1-31% of total applied water on grass covered lysimeters. Amounts of nitrogen fertilizer reaching the groundwater were about 50% for cultivated soil and 5-15% for grass covered soil. (Cassar-FRC)
W82-05768

THE WELLTON-MOHWAK DILEMMA,
Science and Education Administration, Riverside, CA. Salinity Lab.
J. Van Schilfgaarde.
Water Supply and Management, Vol 6, No 1-2, p 115-127, 1982.. 2 Fig, 5 Tab, 9 Ref.

Descriptors: *Irrigation effects, *Salinity, *Irrigation efficiency, *Desalination plants, *Economic aspect, *Colorado River, Desalination, Water management, Irrigation programs, Irrigation practices, Irrigation water, Irrigation-return flows, Rate of return, Water pollution sources.

The Wellton-Mohawk irrigation project near Yuma, Arizona involves the conveyance of Colorado River waters to lands in and above the Gila River Valley. To alleviate waterlogging and salinity problems caused by the project, numerous pump drains were installed, which resulted in significant increases in the salinity levels of downstream waters in the Mexicale Valley. The United States has planned an expensive desalting plant to upgrade water salinity levels to be in accordance with the 1973 Water Treaty with Mexico. Improving irrigation management practices in the area of the Wellton-Mohawk project was considered a more cost-effective approach, but one that was difficult to implement based on economic return. If irrigation efficiency is increased and return flows decreased, the size of the proposed desalting plant may be reduced. (Geiger-FRC)
W82-05883

FUTURE WATER DEVELOPMENT POLICIES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W82-05884

OPTIMAL SALINITY CONTROL PROGRAM FOR THE UPPER COLORADO RIVER BASIN,
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
For primary bibliographic entry see Field 5G.
W82-05893

SALINITY CONTROL MEASURES FOR GRAND VALLEY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe, W. R. Walker, and R. G. Evans.
Water Supply and Management, Vol 6, No 1-2, p 129-167, 1982. 14 Fig, 7 Tab, 28 Ref.

Descriptors: *Desalination, *Irrigation effects, *Colorado river, *Salinity, *Irrigation efficiency, *Irrigation-returnflow, *Canal linings, Water quality control, Groundwater management, Irrigation engineering, Irigation canals, Irrigation practices, Saline water, Irrigation water, River basins, River basin development.

Irrigation return flows which contact the marine deposited Mancos shale enter aquifers of the Grand Valley in west central Colorado and cause excessively saline waters to reach the Upper Colorado River Basin. Various measures are studied for reducing the salt load from this area. On-farm improvements to reduce irrigation return flows include irrigation scheduling, head ditch linings, and sprinkler and trickle irrigation. Other approaches are conveyance channel linings, field relief drainage, taxation and land retirement, modified legal constraints, and collection and desalting of return flows. A restructuring of the local irrigation system lying below the turnouts from the major canal systems would be the best procedure for salinity control in the waters of the Grand Valley. At higher levels of valley-wide salinity control, emphasis should be placed on canal linings for other irrigation canals in addition to the Government Highline Canal. Only after major irrigation system improvements are implemented would desalination become a cost-effective means of salinity control. (Geiger-FRC)
W82-05894

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4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ON-SITE STORMWATER DETENTION: AN OVERVIEW,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
J. M. Mason, Jr.
Public Works, Vol 113, No 2, p 62-64, February, 1982. 2 Fig, 3 Ref.

Descriptors: *Storm water, *Runoff, Flood control, Storm runoff, Detention reservoirs, *Urban runoff, Surface runoff, Dry wells, Trenches, Ditches, Economic aspects, Ponds, Cisterns, *Sewer systems, *Water pollution control.

Street runoff is composed of many pollutants also found in sanitary sewage, along with considerable amounts of metals. Various measures may be taken to collect contaminants before they enter the sewer system. The objective of detention facilities in general is simply to regulate the runoff from a storm by distributing it over a longer time period. Methods include surface storage using dry ponds, wet ponds, parking lots, shallow surface catchments, and subsidiary fill impoundments; rooftop storage; underground storage with trench, pipe and cistern storage and tunnel-reservoir systems; and infiltration storage such as dry wells and infiltration trenches. To control the discharge from small on-site detention basins, a number of outlet structures are needed: pipe/culvent, perforated riser pipe, weir, or a special outlet control box. An emergency spillway must be provided in the event of a critical storm that exceeds the basins's design frequency. The preferred location of an emergency spillway is on undisturbed ground rather than over a prepared embankment. The emergency spillway must be sufficiently protected to eliminate any potential erosion. Efforts should be made to direct the spillway away from high value property and toward the natural drainage pattern. Economic justification for constructing the facilities for control of stormwater runoff has been that they enhanced the value of the areas affected. Other benefits would be the creation of recreation areas and the replenishment of the ground water supply. Identifying the beneficiaries of flood and pollution control projects is an important consideration in allocating the costs of such improvements. (Baker-FRC)
W82-04758

RESISTANCE OF BEAUHARNOIS CANAL IN WINTER,
National Water Research Inst., Burlington, (Ontario).
For primary bibliographic entry see Field 2C.
W82-04998

PREDICTION OF WATER LEVEL IN TIDAL INLET,
Kanazawa Inst. of Technology (Japan). Dept. of Civil Engineering.
K. Mizumura.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW1, p97-106, February, 1982. 13 Fig, 10 Ref.

Descriptors: *Model studies, *Intake gates, *Water level fluctuations, *Tides, *Lakes, *Regression analysis, Mathematical models, Hydraulic models, Irrigation water, Filtration, Mathematical studies, Inlets, Theoretical analysis, Markov process, Prediction, Tidal lakes, Lake Kahokugata, *Japan.

In order to control the water quality and quantity of tidal lakes, the operation of gates at the inlets must be undertaken with extreme care. Water flow through the inlet must be sufficient for crop irrigation without being high enough to cause flooding. In order to optimize gate control, water levels downstream are predicted by a combined model which uses regression theory and control theory. In the first part of this two part model, a regression equation is used along with sea levels to predict the water levels downstream of the gate. In the second part, a Kalman filtering algorithm is utilized to identify parameters used in constructing the state equation . The model was applied to problems of estimating water levels on the downstream side of the gate at the Lake Kahokugata inlet in Ishikawa, Japan. It was possible to determine changes in water levels under the arbitrary gate operations one or two hours before the actual water fluctuation events. Use of Kalman filtering made possible the realtime prediction of water levels when the second order Markov model was employed. (Geiger-FRC)
W82-05005

NEW METHODS OF DESIGNING FLOOD CONTROL MEASURES,
For primary bibliographic entry see Field 2E.
W82-05030

MAN-MADE STORAGE OF WATER RESOURCES--A LIABILITY TO THE OCEAN ENVIRONMENT. PART II,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
H. J. A. Neu.
Marine Pollution Bulletin, Vol 13, No 2, p 44-47, February, 1982. 2 Fig, 6 Ref.

Descriptors: *Water storage, *Environmental effects, *Seasonal variation, Balance of nature, Hydroelectric power, Salinity, Canada, Reservoirs, Water resources development, Estuaries, Fisheries, Marine fisheries, Runoff, Marine biology, Powerplants, *Regulated flow, *Ecological effects, Ocean circulation.

Regulating natural seasonal runoff for power production may product serious damage to marine life. Biological activities in large ocean currents such as the Gulf Stream depend on a seasonal nutrient supply, which in turn is regulated by the seasonal fresh water runoff. Modifications of these patterns, which have evolved over thousands of years, may be responsible for declines in fish catches, as seen in the late sixties and early seventies off the North Atlantic Coast. Other areas where marine life has been disturbed by water resources development are the Nile Delta, the Black and Azov Seas, and the Grand Banks of Newfoundland. Over 300 water storage projects have been built in Canada during the last 25 years. This has changed the balance of water storage in this region from the natural ratio of 4:1 (summer:winter) to 3:2. Possibilities for achieving more natural seasonal flows are power production without storage (run of the river stations), closed-circuit twin lake systems in which water is pumped into the upper lake during periods of low power demand and excess available energy, and determining the minimum spring flow necessary to maintain primary production in estuaries. (Cassar-FRC)
W82-05126

PREDICTIVE MODELS OF BENTHIC MACROINVERTEBRATE DENSITY FOR USE IN INSTREAM FLOW STUDIES AND REGULATED FLOW MANAGEMENT,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 8I.
W82-05194

DEVELOPMENT OF NATURAL SUBIRRIGATION OF LANDS AND ITS PREDICTION NEAR LARGE RESERVOIRS,
Northern Scientific Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR).
G. N. Petrov.
Water Resources, Vol 8, No 2, p 155-164, March-April, 1981. 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 2, p 98-108, March-April, 1981.

Descriptors: *Waterlogging, *Reservoirs, *Subirrigation, Soil water, Environmental effects, *Dam effects, Drainage, Hydrophytes, Swamps, Wetlands, Water level fluctuations, Capillary water, Saline soils, Demineralization, Vegetation, Soil saturation, *USSR.

Natural subirrigation, an adverse result of building reservoirs on flatland rivers, may affect areas of 0.5 to 3000 ha, according to investigations of several large reservoirs in Russia. A consequence of subirrigation is waterlogging of the soil, leading to the development of swamps, increase of soil acidity, salinity, gleization, and transformation into meadows. A succession of vegetation from mesophilic to hydrophilic occurs over a number of years. Several conditions which promote the development of subirrigation are: increase in humidity on the low windward shores, wind-induced denivellation phenomena accompanied by tilting of the water surface and flooding, raising the reservoir level above normal, daily and weekly variations up to 1 m of the water level, closed small depressions, rapid spread and slow decomposition of hygrophytes with tubers and rhizomes, disturbance of soil by grazing cattle, enclosing subirrigated lands (which encourages deposition of debris), existence of low spots many km from the reservoir, and fine-textured soil. Studies on prediction of subirrigation are described. (Cassar-FRC)
W82-05238

THE UTILIZATION OF GRASS CARP, CTENOPHARYNGODON IDELLA VAL., FOR HYDRILLA CONTROL IN LAKE BALDWIN, FLORIDA,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
J. V. Shireman, and M. J. Maceina.
Journal of Fish Biology, Vol 19, No 6, p 629-636, December, 1981. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Vegetation, *Fish, *Aquatic weed control, Aquatic plants, *Water pollution control, Eutrophication, *Florida, Lakes, Lake Baldwin, Carp, Hydrilla, Plant growth.

The effectiveness of grass carp in control of hydrilla was investigated by stocking Lake Baldwin, Florida with this control agent during 1978 at a rate of 24 fish per ha. At two years after stocking, hydrilla was nearly eradicated from the lake. Control was effective with 130 kg grass carp/ha of hydrilla, and control was definite when biomass exceeded 185 kg/ha of hydrilla. During the first two years the growth of grass carp was rapid,as the fish reached 9.17 kg by June of 1980. Grass carp greater than 6 kg in weight consumed 25-28% of their body weight of hydrilla per day. The use of grass carp for vegetation management is discussed. It is proposed that three methods can be used to manage vegetation with grass carp; method selection depends on the management goal. First, stock sufficient grass carp to completely remove vegetation. Second, stock grass carp in low numbers to remove vegetation at a slow rate which achieves desired vegetation levels after three to four years and adjust grass carp numbers as needed. Or, third, use chemical or mechanical methods to achieve control within the first year and stock only enough grass carp to maintain this level. The third option appears to offer the best possibilities. Grass carp should be stocked (0.5 kg) during the first winter at 5-6 fish/ha of hydrilla. This should be sufficient to consume regrowth. (Baker-FRC)
W82-05274

SEASONAL RISK-BASED RESERVOIR OPERATING RULES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. P. Ballestero.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224742, Price codes: A10 in paper copy, A01 in microfiche. PhD. Thesis, Spring 1981. 189 p, 108 Fig, 9 Tab, 61 Ref, 4 Append. OWRT B-195-COLO(4).

Descriptors: *Reservoir operation, *Operating policies, *Probabilistic process, *Risks, *Seasonal variation, Economic aspects, Reservoir storage, Water storage, Reservoirs, Management planning,

Planning, Estimating, Priorities, Prediction, Forecasting, Projections, Policy making, Water supply systems, Water supply, Water scarcity, Water loss, Water management, *Hazardous materials, Spills.

Research was carried out to develop a capability to predict short-term (seasonal) effects of various reservoir operation policy on future failure (spill or deficit) probabilities, based on application of the concept of the Anticipated Decision Influence Period (ADIP). The ADIP is defined as the time from the present to the end of the current failure (spill or deficit) period. Three methods of identifying the ADIP and two types of risk-based rule schedules were tested. Two reservoirs were analyzed: one with almost insignificant overyear storage; one with considerable overyear storage. It was concluded that the risk-based rules yield improvement over standard normal conditions for the small reservoir, with improvements being magnified for the large reservoir. Three steps were used to formulate reservoir policy based on the future failure volume distribution and implementation of the policy if future failure probability criteria were violated. This was followed by the mapping out of the results of various levels of action to decrease future failure risk. Thus, future failure risk may be decreased and the magnitude of the decrease may be controlled. (Zielinski-MAXIMA)
W82-05299

INTEGRATED MANAGEMENT OF WATER DEFICITS AND FLOODS IN A RESERVOIR SYSTEM,
Centro Teoria dei Sistemi, Milan (Italy). Ist. di Elettrotecnica ed Elettronica.
P. Bolzern, G. Fronza, F. Garofalo, and G. Ambrosino.
Journal of Environmental Management, Vol 13, No 1, 1981. p 1-12. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Reservoirs, *Flood control, Mathematical studies, *Statistical methods, Stochastic processes, Management planning, Multipurpose reservoirs, Reservoir storage, Reservoir yield, Simulation analysis, *Optimization, Systems analysis, Flood data, *Reservoir operation.

A reservoir management approach is described. The approach assumes that inflow forecast is one of the driving variables of reservoir operation and avoids fixing a minimum advisable freeboard. The design also takes into account both short- and long-term objectives, specifically, mitigation of downstream water deficiencies and mitigation of flooding adjacent to the reservoir. The first goal is addressed in an optimization model which prescribes a schedule of releases on the basis of current storage and forecast inflows. The second goal is addressed in daily yield decisions based on flood control requirements. (Titus-FRC)
W82-05325

FLOOD CONTROL AND FLOW REGULATION PROBLEMS ON THE ASSINIBOINE RIVER,
Manitoba Dept. of Natural Resources, Winnipeg.
N. Mudry, G. H. MacKay, and V. M. Austford.
Canadian Water Resources Journal, Vol 6, No 4, p 157-173, 1981. 1 Fig, 4 Ref.

Descriptors: *Flood control, *Water management, *Enviromental effects, Diversion structures, Flood protection, Flow regulation, *Assiniboine River, *Manitoba, Floodways, Flood channels, Reservoirs, Sheelmouth Dam, Brandon, Winnipeg, Portage-la-Prairie, Land acquisition, Water conveyance, Water quality, Drainage, Water supply, Intakes, Flood plains, River basins, Water resources development, Canada.

Several unanticipated problems have resulted from the flood control and flow regulation projects on the Assiniboine River in the Winnipeg, Manitoba, region. The control structures include a floodway to divert Red River water around Winnipeg, a diversion channel to convey floodwaters from the Assiniboine River to Lake Manitoba, the 35-mile long Shellmouth Reservoir on the upper reaches of the river, and a dike system within Winnipeg and in agricultural regions between Portage-la-Prairie and Winnipeg. Criteria for land acquisition at the head of the reservoir were relaxed to allow private ownership of 160-200 ha of 607 ha of marginally affected land below the 431.3 m level. This was a mistake, because the drainage time on this land was substantially increased after reservoir construction. Flooding and impeded drainage have also increased in cultivated land directly downstream from the dam. Adjustment of flow rates to solve this problem would greatly increase flooding further downstream. The major algae blooms on the reservoir have affected municipal water supplies as far downstream as Brandon, especially at flows of 8.5 cu m per sec or less. A winter water supply intake for the Portage-la-Prairie municipal supply does not perform as designed because flow fluctuations and high silt levels cause damage and operational problems in the pumping system. In addition, heating of equipment and a larger staff are necessary. There is also a danger of ice damage to the conduit gate. The diversion channel to Lake Manitoba has caused silt damage and poor drainage in adjacent farmlands. Since the government did not buy all the land for the Assiniboine River dike system prior to construction, there have been problems with farmers removing dikes, with dike maintenance, and with subsequent land acquistion. (Cassar-FRC)
W82-05389

CALIFORNIA'S PERIPHERAL CANAL: SKIRTING THE DELTA - AND THE ISSUES,
T. Pfaff.
Environment, Vol 24, No 3, p 25-35, April, 1982. 6 Fig, 22 Ref.

Descriptors: *Water resources development, *Canals, *California, Peripheral canal, *Sacramento River, Construction, Financial aspects, Public opinion, Ecological effects, Planning, Diversion structures.

The proposed peripheral canal to be built in California is described. The canal would be the largest public works project in world history. The issue is complex and needs to be viewed from many perspectives. An overview of the state's geography and hydrology is an important factor. At its proposed size the canal would have an annual capacity of 16.3 MAF of water. At peak operating levels it could divert as much as 70% of the Sacramento River's average flow. From the start environmentalists have expressed concern about the effects such a diversion would have on water quality in the Sacramento-San Joaquin Rivers and San Francisco Bay. Even without the canal Delta conditions are deteriorating. Some officials claim that the canal would solve the problem of reverse flow, but others caution against this view. Both recreational and commercial fishermen have long opposed the water projects that pose so great a menace to the important fish populations of the area. While much has been said about the long term effects of the canal, relatively little has been thought about the immediate effects. If conservation and wastewater reclamation would obviate the need for some facilities, it would seem difficult to justify the phenomenal expense of building the various facilities. The peripheral canal alone would cost about $1.3 billion by the time it would be completed. The costs of construction are only a beginning. It would take a tremendous and continual supply of electricity to transport water within California. (Baker-FRC)
W82-05411

PROBLEMS OF THE MULTIPURPOSE USE OF WATER RESOURCES OF THE VOLGA-AKHTUBA FLOODPLAIN AND VOLGA DELTA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
G. V. Voropaev, and T. N. Ivanova.
Water Resources, Vol 8, No 2, p 107-114, March-April, 1981. 2 Tab, 6 Ref. Translated from Vodnye Resursy, No 2, p 12-21, March-April, 1981.

Descriptors: *Multipurpose projects, *Reservoirs, *Water management, Volga River, USSR, Caspian Sea, Water resources development, Agriculture, Irrigation, Fisheries, Interbasin transfer, Diversion, Hydro-electric plants, Reservoir releases, Regulated flow, Water transport, Streamflow forecasting, Water distribution, Rivers, Water transfer, Deltas, Flood plains.

Problems exist in management of water in the Volga River Basin, a heavily populated agricultural and industrial region of Russia. Large water losses occur in non-wet years (85-90% of the time) because water management below Volgograd has not been changed to meet the conditions produced by the controlled management above Volgograd. Conflicts in consumer demand are especially apparent in spring and in dry years. The hydropower, water transport, and irrigation interests favor storage of water in spring, with subsequent release during the year. The fishery and agricultural consumers in the lower reaches prefer a more unregulated flow. The planned water management programs designed to operate under conditions of controlled spring flood have been tried in the lower Volga reaches since 1959. Since it is difficult to forecast the optimal release, desired results are rarely achieved. The level of the Caspian Sea has been dropping and the water quality deteriorating. The spring releases also cause electric power production losses at the lower river hydrostations during the second quarter. These problems will become more serious and complex as water consumption in the region increases and the planned diversions to the Don and Ural Rivers are accomplished. Measures to alleviate the problems and reduce waste include development of intensive irrigated agriculture and controlled fisheries, improvement in techniques for forecasting river flow and economic effects, creation of better models to determine procedures for automatic control of reservoirs, and construction of a water distributor at the apex of the delta to sustain the flow in the Volga tributary (Buzan) at an acceptable level and lengthen the flood period for fish reproduction. (Cassar-FRC)
W82-05487

DISCRETIZATION IN STOCHASTIC RESERVOIR THEORY WITH MARKOVIAN INFLOWS,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 6A.
W82-05524

MULTIPLE OBJECTIVE PLANNING OF LAND/WATER INTERFACE IN MEDIUM SIZE CITIES: APPLICATION TO WEST LAFAYETTE, INDIANA,
Purdue Univ., Lafayette, Ind. Water Resources Research Center.
G. V. Loganathan, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236647, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 144, March, 1982. 119 p, 16 Fig, 16 Tab, 48 Ref, 1 Append. OWRT-A-057-IND(4), 14-34-0001-1116.

Descriptors: *Land use, *Urban runoff, *Water quality, *Planning, *Simulation analysis, Urban planning, Multivariate analysis, Decision making, Overflow, Pollution load, Urban drainage, Water storage, Storm water, Storm runoff, Storn-overflow sewers, Mathematical studies, Detention reservoirs.

Research was focused on the conflicting goals of land use expansion and the control of urban runoff effluent quality. A probablity distribution approach was used to obtain the distribution of the overflows and of pollutant concentration levels in the receiving stream. At the planning level, this approach is simpler than the simulation approach developed in previous research. This study also extends the theory of milti-criteria decision-making; (MCDM); the application of which to West Lafayette shows it to be a viable tool which deserves further study. The nearly-developed probability distributions provide a simple but powerful methodology for solving urban stormwater problems in estimating the size of the required detention storage, the reliability of the treatment system, and the size of the treatment plant for a given reliability level. The general MCDM prob-

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lem theory was extended by development of a new cutting plane algorithm. The probability distribution for the receiving stream pollutant concentration requires further research. Study of the potential for developing joint distributions for different hydrologic variables is also recommended. (Zielinski-MAXIMA)
W82-05550

EVALUATION OF SNOWMELT FORECASTING METHODS,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier, K. A. Erickson, and D. B. Parkinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236662, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 68, December, 1980. 70 p. 11 Fig, 12 Tab, 20 Ref. OWRT A-104-WASH(1), 14-34-001-0151.

Descriptors: *Snowmelt, *Runoff forecasting, *Model studies, *Model testing, Thaw, Runoff volume, Runoff rates, Flood forecasting, Prediction, Projections, Water storage, Watershed models, Converter models, Hydrologic models, Statistical models, Evaluation analysis, Mathematical studies, Watersheds, Weather forecasting.

Snowmelt runoff forecast accuracy has significant economic implications for water resources management (especially for hydroenergy production and agricultural irrigation). Assessment of snowmelt forecasting methods was conducted as part of an on-going study of streamflow forecasting methods. Retrospective forecasts were made for two western Washington rivers using the National Weather Service snowmelt and soil moisture as state-of-the-art conceptual models (CMs), and the Tangborn hydrometeorological model as representative of the more sophisticated of the storage index (SI) models. Analysis of about 20 years of forecast data for both river basins indicated the CMs performed no better than the SI model, despite greatly increased logistical requirements. Analysis of four years of extreme low runoff data also showed no conclusive differences in forecast accuracy between the CMs and the SI model. Calculations made to determine the limiting forecast accuracy for the CM (conditions on the statistics of monthly simulation errors) showed that simulation error (largely dependent on data network density) probably limits forecast accuracy, especially for late runoff season forecasting; this implies that significant forecast accuracy improvements for CMs may not be possible, given current data limitations for many mountainous watersheds. Two situations are identified in which CMs are preferred over the SI model. (Zielinski-MAXIMA)
W82-05552

MODIFICATIONS TO STEAM CHANNELS IN THE BRISBANE METROPOLITAN AREA, AUSTRALIA,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton, and R. J. Neller.
Environmental Conservation, Vol 8, No 4, p 299-306, Winter, 1981. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Water management, *Environmental effects, *Urban runoff, Streamflow, Channel improvement, Channel morphology, Brisbane, Australia, Urban watersheds, Flood control, Urban drainage, Dams, Water supply, Runoff, Highways, Dredging.

The environmental impacts of human activities (urban development, water resources development, and dredging) in Brisbane, Australia, at the mouth of the Brisbane River are documented. One steam, the Big Creek, formerly used as the city's principal water supply, now flows through pipes under the central city; no traces of its course are visible on the surface. Several dams in the Brisbane watershed have affected the geomorpholgical characteristics of the streams by trapping sediment and reducing flows. Flood control works such as channel dredging and straightening now aid in carring stormwater runoff. Freeway construction has resulted in eliminating some creeks and digging new channels. Flood storage capacity in the Norman Creek valley has been reduced. Culverts and man made channels in the Freeway area have completely changed the characteristics of the stream channel. Enlargement of Brisbane Airport will cover Serpentine Creek, requiring construction of a new floodway. Sand, gravel, and other building materials have been dredged from streams for many years forming, in some cases, man made lakes. Sediment is trapped in these lake areas, causing degradation downstream. In other places sediment concentrations in water are greatly increased by excavation of clay and sand. Suburban development has affected characterisics of the streams by increased runoff from impervious areas and by increased flow velocity in artificial channels. (Cassar-FRC)
W82-05572

ISSUES IN SIMULATION MODEL DESIGN--A CASE STUDY,
Waterloo Univ., (Ontario). Dept. of Civil Engineering.
E. A. McBean.
Journal of Hydrology, Vol 51, No 1-4, p 205-218, May, 1981. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Simulation analysis, *Model studies, Mathematical models, Water resources development, Planning, Reservoirs, Irrigation, Hydroelectric power, Water transfer, Computers, *Argentina, Rio Colorado(Argentina).

Computer simulation of potential river basin development, until recently merely an interesting academic exercise, is now a practical enginering procedure of increasing utility in water management. As a result of the limitations on accuracy and fidelity inherent in all-encompassing models, many modeling studies tend toward the use of a number of relatively limited mathematical models, each of which is restricted in the scope of questions which it addresses, while still useful for providing particular insights into the planning problem. The simulation model described in this paper was one of four models developed as part of a large basin-planning study of the reservoir capacities, irrigation areas, diversions and hydroelectric installations for the Rio Colorado, Argentina. A governing criterion in designing this simulation model was the ability to accept from and provide information to the other models used in the study. The computational and data efficiency of the model, the output characteristics of the model, and the maintenance of a general structure which would enhance the ease of use on other basin planning problems were also major concerns in designing the model. The model utilizes the following types of required input data: system definition, economic data, structural data, and hydrologic data. Efforts have been made in designing the model to minimize the disturbance of the data deck required for the investigation of minor changes to the system components. The model was successfully applied as input to a large planning study of the Rio Colorado basin. It is capable of solving problems of about 100 event points for a 50-year simulation, three seasons per year, for about $10.00. (Carroll-FRC)
W82-05627

A REVIEW OF CATCHMENT EXPERIMENTS TO DETERMINE THE EFFECT OF VEGETATION CHANGES ON WATER YIELD AND EVAPOTRANSPIRATION,
Jondershoek Forestry Research Station, Stellenbosch (South Africa).
For primary bibliographic entry see Field 4C.
W82-05647

THREE-STATE MARKOV MODEL FOR DIFFERENTIAL PERSISTENCE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05654

TIME AND FREQUENCY DOMAIN ANALYSES OF HYDROLOGICAL SYSTEMS,
Federal Inst. of Hydrology, Coblenz (Germany F.R.).
For primary bibliographic entry see Field 2E.
W82-05655

MODIFIED STANDARD OPERATION RULES FOR RESERVOIRS,
Technische Hochschule, Aachen (Germany, F.R.). Hydropower Div.
F. G. Rohde, and K. Naparaxawong.
Journal of Hydrology, Vol 51, No 1-4, p 169-177, May, 981. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Operating policies, *Reservoir operatin, Standards, *Optimization, Planning, Mathematical studies, *Simulation analysis, *Reservoir releases, Reservoir storage.

The problem of optimal reservoir operation occurs both in the planning phase, when operational costs and benefits related to different system designs must be assessed, and in the production phase, for the development of real-time management policies for existing systems. In the planning phase, two principal rules are widely applied: the standard operation rule and linear decision rules, derived either by implicit or explicit stochastic optimization techniques. The modified standard operation rule, which controls not only the reservoir release, but also the reservoir storage, provides a further alternative. Rules of this type are most widely applied in real-time reservoir operation. A procedure for the derivation of modified standard rules which uses time-dependent upper and lower storage bounds determined by a two-stage optimization process is presented. The application of this technique to an existing two-reservoir system in Thailand, which produces hydroelectric power, irrigation water, and low-flow augmentation for salinity control, is discussed. Long term simulations were used to compare the derived rule with the rules presently used in real-time operation. These simulations showed that, although the difference in system output in absolute terms was small, the operation with the new rule resulted in the increase of firm energy, non-firm energy and dependable capacity and in the decrease of frequency and volume of reservoir spills. (Carroll/FRC)
W82-05658

MULTI-DECISION ANALYSIS FOR LARGE-SCALE RIVER-BASIN RESERVOIR SYSTEMS,
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 2E.
W82-05659

A CONSISTENT METHODOLOGY FOR WASTELOAD ALLOCATIONS,
Hays and Lindsey, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W82-05702

IDENTIFICATION OF INDEPENDENT RAINSTORMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W82-05708

SOME CHARACTERISTICS AND IMPLICATIONS OF DRAINAGE BASIN LINEARITY AND NON-LINEARITY,
Nebraska Univ., Omaha. Dept. of Civil Engineering.
W. F. Rogers.
Journal of Hydrology, Vol 55, No 1/4, p 247-265, 1982. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Drainage engineering, *Runoff volume, *Linearity, Hydrologic models, *Rainfall-runoff relationships, Peak discharge, River basins, Precipitation, Design criteria, Unit hydrographs, Hydrographs.

In linear drainage basins runoff volume is directly proportional to precipitation volume, whereas in nonlinear drainage basins it is not. When the slope of the mathematical linear equation describing the

second-order standardized peak discharge distribution (SSPDD) is about -1.00, the drainage basins are linear. If the slope is less than -1.00, the drainage basin is nonlinear. The degree of nonlinearity is indicated by the magnitude of the negative slope of the SSPDD. The small- and medium-sized basins (up to 450 sq mi) studied had slopes from -1.02 to -2.83, mean -1.38. Using linear design procedures such as the unit hydrograph in nonlinear basins can result in serious overdesign. Peak discharge from Codorous Creek, Pennsylvania, drainage area 73.4 sq mi with a nonlinear slope of -1.39, was overestimated by 72% using linear equations. (Cassar-FRC)
W82-05710

LINEAR AND NONLINEAR RUNOFF FROM LARGE DRAINAGE BASINS,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
W. F. Rogers, and H. A. Zia.
Journal of Hydrology, Vol 55, No 1/4, p 267-278, 1982. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Drainage engineering, *Runoff volume, *Linearity, Snowmelt, Hydrologic models, Rainfall-runoff relationships, Peak discharge, Precipitation, Design criteria, Hydrographs, Unit hydrographs, River basins.

The second-order standardized peak discharge distribution (SSPDD) procedure described in a previous paper was applied to large drainage basins, 450 to 8190 sq mi. These basins showed linearity and nonlinearity with slopes of -1.01 to -1.43 derived from the equations. Even very small runoff volumes (0.001 inch expressed as depth distribution over the drainage basin) fit the distribution well. Twenty-two snowmelt hydrographs from several basins in Nebraska also fit the distribution. (Cassar-FRC)
W82-05711

KINEMATIC WAVE THEORY OF CATCHMENT RESPONSE WITH STORAGE,
Newcastle Univ. (Australia). Dept. of Civil Engineering and Surveying.
W. G. Field.
Journal of Hydrology, Vol 55, No 1/4, p 279-301, 1982. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Runoff, *Storage, *Kinematic wave theory, Rainfall-runoff relationships, Catchments, Excess rainfall, Open-channel flow, Hydrographs, Channel storage, Hydrologic models, Model studies, Urban runoff.

The catchment response model proposed in this paper consists of a continuous distribution of storage elements feeding into a branched channel system. It is assumed that rainfall excess enters the off-channel storage elements (linear or nonlinear) before being transformed to channel elements (linear or nonlinear) for transport to the catchment outlet. The discharge hydrograph is produced from solving the kinematic wave equation using the method of characteristics. Illustrations are given using a rectangular catchment and a linear catchment. It is shown that the model is a generalization of several other well-known models. For a linear catchment the runoff hydrograph is described by a double convolution integral in which the rainfall excess function and catchment time-area function can be interchanged to produce the solution for an equivalent catchment and hyetograph shape. Typical values for runoff coefficients are given for small rural catchments of different soil types and vegetation. For design purposes urban areas may be divided into impervious and pervious subareas. (Cassar-FRC)
W82-05714

FLOODPLAIN ANALYSIS, SIMPLIFIED VS. COMPLEX METHODS: A CASE STUDY,
Enviroscience, Inc., Minneapolis, MN.
I. Yomtovian, and D. Ford.
Water Resources Bulletin, Vol 18, No 2, p 259-263, April, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Flood plain management, *Flood insurance, *Flood profiles, Nonstructural alternatives, Flood damage, Flood discharge, Hydrologic models, Model studies, Maps.

Simple and complex methods of determining flood plain information were compared using data from three North Dakota creeks: Apple, Burnt, and Hay. A simplified manual technique (Soil Conservation Service) and a complex computer technique (HEC-2) produced similar flood plain boundaries. Differences of 1-3 ft in 100-year surface profiles were found in use of the 2 methods. Major differences were in locations near bridges. Simplified methods are recommended for rapid determination of flood hazard, flood information studies, and preparation of inundation maps for flood emergency plans. The complex mathematical models are recommended for determining the 10- and 100-year flood elevations. (Cassar-FRC)
W82-05732

ECONOMIC EVALUATION OF WATERSHED PROJECTS--AN OVERVIEW METHODOLOGY AND APPLICATION,
Minnesota Univ., St. Paul. Coll. of Forestry.
For primary bibliographic entry see Field 6B.
W82-05735

WINTER HEAT BUDGET AND FRAZIL ICE PRODUCTION IN THE UPPER ST. LAWRENCE RIVER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2C.
W82-05736

MODELING OF WATER SUPPLY/DEMAND IN THE SOUTH PLATTE RIVER BASIN, 1970-2020,
Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 6D.
W82-05738

LOCAL ATTITUDES TOWARD ALTERNATIVE USES OF A RESERVOIR PROJECT,
Ohio State Univ., Columbus. Dept. of Development Sociology.
For primary bibliographic entry see Field 6B.
W82-05743

NORMALITY OF HYDROLOGICAL DATA,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7B.
W82-05752

FOREST MANAGEMENT FOR INCREASED WATER YIELD--HOW USEFUL IN SOUTHERN ALBERTA,
For primary bibliographic entry see Field 3B.
W82-05760

RESOLVING THE FISH VS FLOOD CONTROL CONTROVERSY ON THE VEDDER RIVER,
E. Bonham.
Canadian Water Resources Journal, Vol 5, No 1, p 38-53, 1980. 1 Fig, 3 Ref.

Descriptors: *Flood control, *Fisheries, *Channel improvement, Vedder River, British Columbia, Flood plain management, Dikes, Dredging, Bank protection, Sedimentation, Gravel, River beds, Water management.

A destructive flood of the Vedder River, British Columbia, in December 1975 prompted immediate remedial work--repair of the existing bank protection, scalping of major bars, burning of wood debris (completed March 1976), and removal of 750,000 cu yards of gravel from the main channel in July-August 1976. A management plan was devised as a long-term solution to accommodate both flood protection against a 200-year event and the salmon and trout fisheries. Strategies include increasing the floodway width and construction of 10 ft high gravel setback dikes, provision of ten 8' x 8' culverts in the railway embankment near the B. C. Hydro bridge constriction, and floodboxes within the setback dikes to enhance fish spawning. Cost estimates for the project, expected to be finished in 1982, are $1.8 million. The Vedder River Management Committee was formed in April 1980 with representatives in flood control, fisheries, wildlife, recreation, and agriculture. Major activities of the Committee will be to accommodate the conflicting interests, devise a long-term river sedimentation and gravel removal program, administer leasing of flood plain land for grazing and haying, and establish a riverside campsite. (Cassar-FRC)
W82-05765

TELEMETRY AND REAL TIME ENVIRONMENTAL DATA ACQUISITION (LA TELEMETRIE ET L'ACQUISITION EN TEMPS REEL DES DONNEES SUR L'ENVIRONNEMENT),
For primary bibliographic entry see Field 7B.
W82-05770

WATER MANAGEMENT IN THE MARITIMES,
New Brunswick Dept. of Fisheries and Environment, Fredericton.
For primary bibliographic entry see Field 6B.
W82-05776

THE MACKENZIE RIVER BASIN STUDY,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
H. Foerstel.
Canadian Water Resources Journal, Vol 5, No 2, p 13-27, 1980. 4 Fig, 4 Ref.

Descriptors: *Canada, *Water management, *Data collections, *Mackenzie River, History, Network design, River basins, Slave River, Deltas, Floods, Planning, Water policy.

The 3-year Mackenzie River Basin study, scheduled for completion in August 1981, covers a vast area (one-fifth of Canada) for which little data has been compiled. The study's main objective is to plug the many gaps in information. Because of the remoteness and enormous size, severe weather, and torrential flows in spring, information was scarce on precipitation in the mountains, the weather, water quality, the Slave River Delta, the Liard River spring ice breakup, the interrelations in the alluvial ecosystem, and the Athabasca Sand Dunes. All these fields have been under study. Some of the difficulties encountered in this basin study are the vast size (which required consideration of scales varying from very local to almost continental), the enormous but still inadequate amount of data, the verbosity of reports, long distance effects, and multiple interests. (Cassar-FRC)
W82-05778

THE OKANAGAN BASIN AGREEMENTS--AN EXAMPLE OF INTEGRATED WATER RESOURCE PLANNING IN BRITISH COLUMBIA,
For primary bibliographic entry see Field 6E.
W82-05779

WATER FLUCTUATION AND THE AQUATIC FLORA OF LAKE MICCOSUKEE,
Florida Dept. of Natural Resources, Tallahassee Bureau of Aquatic Plant Research and Control.
D. P. Tarver.
Journal of Aquatic Plant Management, Vol 18, 19-23, 1980. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Water level fluctuations, *Aquatic plants, *Weed control, Lakes, Lake Miccosukee, Florida, Aquatic weeds, Drawdown, Vegetation, Sediments, Lake sediments, Organic matter, Plant populations, Aquatic weed control.

In an attempt to control aquatic plant growth Lake Miccosukee, Florida, a shallow 2954 ha lake, was drawn down 1.7 m, so that by September 1977 90% of the lake bottom was exposed to drying conditions. Water level returned to normal by April 1978. Total water surface coverage in summer was 81% before drawdown (June 1976)

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and 75.6% after drawdown and refilling (June 1978); in winter 62% before drawdown (February 1977) and 26% after drawdown and refilling (February 1979). Some plant species were considerably reduced as a result of drawdown: water shield, cabomba, variable leaf milfoil, water willow and related plants, and bladderwort. Several other plant types increased in abundance or remained at constant levels: azolla, duckweed, bog mat, frog's bit, yellow cow lily, fragrant water lily, and terrestrial annuals. Drying and plant desiccation produced compaction and stabilization of sediments. The peat zone decreased 70% in depth (from 6-40 cm to 3-12 cm) and the muck zone, 17% (from 3-40 cm to 3-39 cm). (Cassar-FRC)
W82-05808

HYDROLOGIC RECONNAISSANCE OF THE NOATAK RIVER BASIN, ALASKA, 1978,
Geological Survey, Anchorage, AK. Water Resources Div.
J. M. Childers, and D. R. Kernodle.
Geological Survey Open-File Report 81-1005 (WRI), 1981. 38 p, 18 Fig, 8 Tab, 10 Ref.

Descriptors: *Hydrologic data, *Surface water, *Springs, *Streamflow, Flow rates, Discharge measurement, Floods, Flood peak, Runoff, High water mark, Ice, Bank erosion, Aquatic life, Invertebrates, *Alaska, Noatak River basin, Arctic.

Hydrologic data were collected in 1978 described water resources of the Noatak River basin, Alaska. Streamflow varies seasonally. No flow was observed from the upper part of the basin in late winter (April). In the lower part of the basin springs support perennial flow in the Kugururok River and downstream along the Noatak. The discharge of the Noatak was 150 cubic feet per second in April 1978. During the summer, rainstorms are common, and runoff produces high flow. During August 1978, flow was normal in the basin; unit runoff averaged about 1 cubic foot per second per square mile. The Noatak is a gravel-bed stream of moderate slope. It drops about 1,800 feet in elevation from a point near the head waters to the mouth, a distance of 400 miles. Streambed material in most places is gravel, cobbles, and boulders, maximum riffle depths and pool widths increase in a downstream direction. Stream velocity in August 1978 increased from about 1 foot per second in the upper basin to about 4 feet per second in the lower reaches. High-water marks of the maximum evident flood were found at elevations from bankfull to 5 feet above bankfull. Maximum evident flood unit runoff rates were estimated to be less than 50 cubic feet per second per square mile. Scars produced by ice jams were seldom seen above bankfull. Bank erosion appears to be most active in the lowlands. Water in the Noatak River basin is virtually unaffected by man's activity. Water quality varies with location, weather, season, and source; the water is normally clear, cool, and hard. During late winter sea water intrudes into the Lower Noatak Canyon. Benthic invertebrate community composition and variability suggest the river's undiminished natural quality. (USGS)
W82-05848

COLORADO RIVER DEVELOPMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, and Management, Vol 6, No 1-2, p 29-61, 1982. 10 Fig, 1 Ref.

Descriptors: *Water resources development, *Colorado River, *Resources development, *Reclaimed water, *Project planning, Water supply development, River basins, Water use, Water management, Irrigation water, Water supply.

Since the enactment of the Reclamation Act of 1902, many attempts have been made to develop the water resources of the Colorado River Basin. Some early reclamation projects which played a major role in the development of the western United States are reviewed. Many newer projects including the Central Utah Project and the Central Arizona Project are currently under construction. The Central Utah Project will develop water from Utah Lake, the Provo River, and water tributary to the Colorado River for use in the Uinta Basin and the eastern part of the Bonneville Basin. The Central Arizona Project will provide supplemental Colorado River water to nearly 1 million acres of agricultural land in several Arizona and New Mexico counties and municipal and industrial water for the Phoenix and Tucson metropolitan areas. Additional projects have been authorized but are not yet under construction. The present storage capacity of the Colorado River Basin exceeds 65 million acre-feet, which is more than four times greater than the rivers' mean annual flow. Billions of dollars have already been spend for developing this river basin. (Geiger-FRC)
W82-05887

4B. Groundwater Management

ADVANCED WASTEWATER TREATMENT FOR GROUNDWATER RECHARGE--BERLIN RECHARGE PROJECT (RECYCLAGE ET TRAITEMENT D'EAUX USEES POUR RECHARGER UNE NAPPE SOUTERRAINE: L'INSTALLATION PILOTE DE BERLIN),
For primary bibliographic entry see Field 5D.
W82-04831

BARRIERS TO EFFECTIVE GROUND-WATER MANAGEMENT: THE CALIFORNIA CASE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
K. Knapp, and H. J. Vaux, Jr.
Ground Water, Vol 20, No 1, p 61-66, 1982. 3 Tab, 11 Ref.

Descriptors: *California, *Groundwater management, *Model studies, *Cost analysis, *Groundwater mining, Groundwater depletion, Water demand, Water supply, Water supply development, Water management, Water law, Water policy, Pumping, Available water.

In California, 40% of the annual water needs are met by groundwater which is essentially unmanaged. As surface supplies become scarcer, groundwater depletion becomes more of a concern. A dynamic optimization model was used to show that substantial benefits may be gained from groundwater management in the southern San Joaquin area. The magnitude of these benefits is influenced by energy costs, interest rates, water demand and the availability of substitute surface supplies. The regulatory strategy chosen for management will affect the distribution of benefits. If additional surface water supplies are provided, groundwater mining is permitted even where quality is threatened. Individual fears of economic loss suffered for the collective and uncertain gain to a larger group are a real barrier to the implementation of groundwater management programs. In order to be effective, future groundwater management policies in California will have to be uncomplicated, equitable, flexible, and inexpensive to administer. (Geiger-FRC)
W82-04917

THE POTENTIAL FOR GROUND-WATER MANAGEMENT IN THE WEST: A SYMPOSIUM,
Oklahoma State Univ., Stillwater.
J. W. Westphal.
Ground Water, Vol 20, No 1, p 59-60, 1982. 3 Ref.

Descriptors: *Groundwater management, *Symposium, *Water supply development, *Water policy, *Water table decline, Environmental policy, Groundwater mining, Water resources development, Water rights, Water law, Irrigation water, Aquifers, *Western United States.

Many states in the West have no clear policy on groundwater use. Since a user's rights involve a combination of physical, economic, and social factors, competition among these interests should be expected. About 80% of the total irrigation in the United States takes place in 17 western states. Groundwater in the West constitutes 46% of its domestic use and 44% of its industrial use. This heavy use has resulted in decreasing water tables, especially in the Ogallala aquifer. The depletion of groundwater has caused a decline in streamflow. There seems to be room for careful development and management of groundwater resources in the West without totally exhausting the supply. California and Texas have virtually no groundwater rights law and only New Mexico had water quality standards for groundwater. Oklahoma is the only Western state with an existing comprehensive groundwater law. Five groundwater management studies are presented in a symposium to identify some management issues and see how they relate to economic and social considerations. They cover such topics as groundwater management in California, Arizona and the High Plains area, the Ogallala aquifer, surface water-groundwater interrelationships, and the storage and transmission characteristics of the basalts of the Pacific Northwest. (Geiger-FRC)
W82-04918

GROUND-WATER NETWORK DESIGN FOR NORTHWEST KANSAS, USING THE THEORY OF REGIONALIZED VARIABLES,
Kansas State Geological Survey, Lawrence.
M. Sophocleous, J. E. Paschetto, and R. A. Olea.
Ground Water, Vol 20, No 1, p 48-58, 1982. 14 Fig, 7 Ref.

Descriptors: *Groundwater management, *Networks, *Observation wells, *Water table decline, *Kansas, *Statistical methods, Network design, Water table wells, Monitoring, Test wells, Water table fluctuations, Water surface profiles, Groundwater depletion, Aquifers, Error analysis.

A study of the existing groundwater observation well network in northwest Kansas was designed to formulate the most effective arrangement for evaluating water table levels and monitoring groundwater resources. The theory of rationalized variables was used to estimate the amount of spatial variability of the water table surface. Structural analysis, a statistical procedure that investigates the behavior of a mapped variables with changes in distance, was employed. Semivariograms were used to assess the degree of spatial continuity of the water table. The method was applied to Groundwater Management District No. 4, which holds groundwaters mainly of the Ogallala Formation. The error analysis produced by universal kriging showed that fewer wells would be required for the same level of accuracy if a regular 5.4-km network was used. Reducing the estimation error in the water-table surface uniformly throughout the region proved impractical due to the higher costs of well monitoring. (Geiger-FRC)
W82-04921

ECONOMICS OF DECLINING WATER SUPPLIES IN THE OGALLALA AQUIFER,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
J. Warren, H. Mapp, D. Ray, D. Kletke, and C. Wang.
Ground Water, Vol 20, No 1, p 73-79, 1982. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater management, *Oklahoma, *Model studies, *Groundwater depletion, *Economic aspects, *Irrigation requirements, *Computer models, Aquifers, Crop production, Agriculture, Cultivated lands, Irrigation effects, Irrigation water, Irrigation wells, Water demand, Water supply, Water supply development, *Ogallala aquifer.

Discovery and exploitation of the Ogallala Formation generated dramatic economic growth, primarily based on irrigated agriculture, in the High Plains region of the United States beginning early in the twentieth century. The problem of declining water levels in the Ogallala Aquifer began to attract public attention in the early 1970s. An integrated six-state study was initiated, in which Oklahoma researchers developed a computer model of the agricultural sector of northwestern Oklahoma and estimated irrigated and dryland cropping patterns, farm output and farm income over a 40-year

planning horizon. Sensitivities of the outputs to alternative assumptions on energy costs, commodity prices and technological development were also analyzed. The model was run for a baeline case and two water management alternatives. Preliminary results suggest a favorable outlook for irrigated agriculture in the area through the near to mid term. (Geiger-FRC)
W82-04922

GROUND-WATER MANAGEMENT IN BASALTS,
California Univ., Davis. Dept. of Geograaphy.
M. L. Shelton.
Ground Water, Vol 20, No 1, p 86-93, 1982. 4 Fig, 18 Ref.

Descriptors: *Groundwater management, *Model studies, *Groundwater storage, *Basalts, *Water management, *Groundwater basins, Aquifers, Groundwater recharge, Groundwater mining, Groundwater depletion, Water resources development, Decision making, Hydrologic models, *Columbia River basalts.

The mining of groundwater in the Columbia River basalts of the Pacific Northwest is complicated by the spatial variability of the hydrologic properties of the deep stratified lava flows. This area is experiencing greater demands for groundwater resources due to new irrigation projects and municipal and industrial requirements. Individual basin studies aid in decision making on water management issues and also increase the data on regional groundwater systems. The Deschutes River Basin system in Oregon is described by a distributed-system multiple storage model which gives the magnitude of spatial variations in groundwater recharge, storage, and discharge for this watershed. The functional properties of the basin groundwater system and the presence and magnitude of its interbasin linkages are revealed by input-output analysis. Model simulations of storage and transmission characteristics suggest that basin or regional perspectives are required to fully utilize the groundwater stored in basalts. (Geiger-FRC)
W82-04931

GROUND-WATER DEVELOPMENT IN WESTERN RIVER BASINS: LARGE ECONOMIC GAINS WITH UNSEEN COSTS,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
J. T. Daubert, and R. A. Young.
Ground Water, Vol 20, No 1, p 80-85, 1982. 2 Tab, 14 Ref.

Descriptors: *Groundwater management, *Colorado, Surface water availabilty, *Economic aspects, *Water rights, *Computer models, *Water supply development, Model studies, Groundwater depletion, Water shortage, Water law, Simulation analysis, Digital computers, Irrigation water, Aquifers, Water demand, Water management, Groundwater availability.

In river basins where aquifers are in close hydrologic contact with streams, groundwater development projects can lower water tables and decrease the amount of surface water available for irrigation of cropland. A digital computer simulation model was formulated to study the economic impact of water management policies in the lower South Platte River basin of Colorado. Colorado water law gives priority on appropriation of water to senior water rights holders with the earliest application dates. Those with subsequent dates hold junior rights. Evaluations of an independent water allocation approach showed that surface water owners cannot protect their historical water rights and must cope with costs associated with declining surface diversions. An approach which allocated both surface and groundwater according to prior appropriation protects senior surface water rights, forcing groundwater users to cease pumping or pay full damages. An open access management policy yielded high income benefits but imposed greater costs on the users of surface water when water supply shortages occurred. Regulation of groundwater usage under the appropriation system reduced the losses of surface water users, but greatly reduced the profits of groundwater users. (Geiger-FRC)
W82-04932

REGIONAL MANAGEMENT OF GROUNDWATER RECHARGE AND POLLUTION IN A RAPIDLY URBANIZING AREA: LONG ISLAND, N.Y.,
Cornell Univ., Ithaca, NY., Dept. of Environmental Engineering.
C. A. Shoemaker, and J. P. Leighton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220625, Price codes: A04 in paper copy, A01 in microfiche. Report, March 1982. 53 p, 6 Fig, 16 Ref, 2 Append. B-091-NY(1). 14-34-0001-9087.

Descriptors: Sewerage network, Optimization, Groundwater, 201 regions, Urbanization, *Model studies, *Sewer systems, *Wastewater facilities, Groundwater recharge, Water pollution control, *Groundwater management, *Suffolk County, Long Island, *New York.

Augmentation of a network of sewer lines and wastewater treatment plants is anlayzed using optimization methods. The optimization model uses integer programming to determine the most economical location of wastewater treatment plants and sewer pipe routes. Because of the extraordinarily large number of integer variables, a special procedure was developed to solve the integer programming problem. The optimization model was applied to western Suffolk County in Long Island, N.Y. The patterns of wastewater treatment and collection which the optimization program found to be least expensive were also those which had relatively little recharge of treatment plant effluent to groundwater. Because of concerns that such major changes in recharge patterns would result in decreased streamflows, the optimization model was modified to encourage more recharge to groundwater. Similarly, preferences for preserving 201 boundaries in wastewater treatment and collection were addressed by computing the solution to the optimization model with restrictions which prevented shipment of wastewater from 201 region to another. The results indicated that the cost for wastewater treatment could be as much as $100 M (18%) more expensive if western Suffolk County is forced to consider only local treatment within existing 201 areas instead of more efficient regional alternatives.
W82-04956

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 1 - ENVIRONMENT, HEALTH AND SOCIO-ECONOMICS,
California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 6G.
W82-05214

REFLECTIONS OF THE CHOICE OF SOME PRIORITY AXES OF HYDRAULIC RESEARCH IN THE FIELD OF LAND AND WATER MANAGEMENT,
Rural Department for Waters and Forestry, Paris (France).
R. Darves-Bornoz.
Journal of Hydraulic Research, Vol 19, No 4, p 307-315, 1981.

Descriptors: *Hydraulics, *Agriculture, Agricultural engineering, Irrigation, Water reuse, Water use efficiency, *Water management, *Land management, Drainage, Irrigation efficiency, Priorities.

Priorities for hydraulic research in the area of land and water management are discussed. Agricultural hydraulics plays a major role in how problems relating to global food production and water management are addressed. The saving of water in irrigation and the increased efficiency of its use for crop production are at the core of major world problems. Reuse of wastewaters for agricultural purposes is another area requiring further investigation. International objectives relating to agricultural and rural development in developing countries are partly linked to water control in agriculture. A better knowledge of the terrestrial cycle of water is needed. Water retention in soil for rainfed agriculture, reduction of irrigation water losses, drainage of excess water, and control of recharge to underground waters are the modifying actions of terrestrial cycle of water at the quantity level which need to be addressed by hydraulic research. Means for avoiding salinization of soils and water and pollution of underground water resources and rivers need to be developed to help improve or maintain the quality of water in this cycle. There is a need for a generalized physico-mathematical model of the terrestrial cycle which will permit consideration of the impact of all human actions on the quality and quantity of water. The relationship between irrigation and power resources also needs to be investigated. (Carroll-FRC)
W82-05278

HEAT LOSS FROM RAPID INFILTRATION BASIN IN WINTER,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5D.
W82-05317

GROUNDWATER RESOURCES OF KWAJALEIN ISLAND, MARSHALL ISLANDS,
Hawaii Univ., Honolulu. Water Resources Research Center.
F. L. Peterson, and C. D. Hunt, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236605, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum Report No 63, March, 1981. 38 p, 2 Fig, 4 Tab, 1 Ref, 1 Append. OWRT A-082-HI(1), 14-34-0001-0113.

Descriptors: *Groundwater availability, *Aquifers, *Pump wells, *Water level fluctuations, *Water resources development, Groundwater depletion, Groundwater management, Groundwater recharge, Groundwater storage, Electrical conductivity, Salinity, Water use, Water management, Available water, Water supply.

A detailed 2.5 year study was carried out to assess the magnitude and fluctuation of fresh groundwater resources of Kwajalein Island. Twenty-three observation wells were constructed and monitored with respect to the thickness, areal-extent, and quality of the groundwater lens. Recharge to the fresh groundwater lens averaged 1,140,000 cu m/year (300 million gallons/year (MG/Y)) over the study period, ranging from 893,000-1,450,000 cu m/year (236-383 MG/Y). The average fresh groundwater lens storage was over 1,060,000 cu m (280 million gallons), but fluctuated widely from about 908,000-1,210,000 cu m/year (50 MG/Y) for safe extraction, provided that an additional lens well is constructed. It is recommended that a proposed new pumping code be instituted on a trial basis to better utilize catchment during the wet season, and storm recharge to the groundwater lens during the dry season. In addition, the present salinity monitoring program (electrical conductivity observations) should be continued to permit assessment of any lens changes which might occur from groundwater development from the proposed new lens well. (Zielinski-MAXIMA)
W82-05546

NUMERICAL SIMULATION OF A THICK FRESHWATER LENS: PEARL HARBOR GROUNDWATER MODEL,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W82-05621

EFFICIENT WATER USE IN CALIFORNIA: CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE RESERVOIRS,
Rand Corp., Santa Monica, CA.
D. J. Jaquette.
Journal of Hydrology, Vol 51, No. 1-4, p 187-204, May, 1981. 4 Fig, 9 Tab, 16 Ref.

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Descriptors: *Groundwater management, *Water use efficiency, *Water supply development, Groundwater reservoirs, Reservoir operation, Water policy, Water management(Applied), Surface water, *California, *Conjunctive use.

This paper presents a summary of the findings of the Rand Corporation's study of water use efficiency in California. The study, which produced a wide variety of policy recommendations designed to improve the efficiency of water use in the State, found that an integrated water management plan could result in the development of significant quantities of new water at costs considerably less than the costs of new water from major facilities proposed for the State. The report recommended an aggressive plan for the conjunctive management of surface and groundwater reservoirs. This conjunctive use plan calls for releases in excess of customer needs to be made from the surface reservoirs and delivered to water contractors for groundwater recharge through the flooding of spreading grounds or through surface deliveries to current pumpers. Water shortages would be met by repumping water from the ground. Analysis of the feasibility of this plan showed that conjunctive management is most profitable in areas with high groundwater tables and in river systems with high ratios of average inflow to reservoir storage capacity; that more aggressive conjunctive management can result in the development of significant amounts of new water, perhaps delaying the need for new facilities; that conjunctive management plans benefit significantly from even modest advances in the reliability of long-range weather forecasting; and that conjunctive use is economically viable and physically feasible. It is suggested that the benefits of conjunctive use are attractive enough that the State should direct attention to overcoming the political and institutional barriers to such a management plan. (Carroll-FRC)
W82-05628

DEEP DRAINAGE AND WATER USE OF FORESTS AND PASTURES GROWN ON DEEP SANDS IN A MEDITERRANEAN ENVIRONMENT,
Alcoa of Australia, Pinjarra.
B. A. Carbon, F. J. Roberts, P. Farrington, and J. D. Beresford.
Journal of Hydrology, Vol 55, No 1/4, p 53-63, 1982. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Soil-water-plant relationships, *Recharge, Groundwater recharge, Evapotranspiration, Pastures, Sands, Forests, *Australia, *Neutron activation analysis.

Soil water content was determined beneath three different types of vegetation growing in deep sands of southwestern Western Australia for the purpose of studying deep drainage and aquifer recharge. The climate in this region is Mediterranean (cool, rainy winters and hot, dry summers). The neutron scattering method was used for field measurements in native hardwood forests, softwood plantations, perennial pastures, and winter annual pastures. Results indicated that deep drainage was greatest under winter annual pastures and least under Pinus pinaster (Ait.) plantations. Perennial pastures and native forests were similar in water use patterns, soil water depletion and deep drainage, contributing about 34% of the annual water balance to deep drainage. Thus replacing natural forest with pine plantations would decrease groundwater recharge, while replacing with annual pasture would increase recharge. (Cassar-FRC)
W82-05629

TRACING INTERAQUIFER CONNECTIONS IN THE KEFAR URIYYA-AGUR REGION (ISRAEL), USING NATURAL URANIUM ISOTOPES,
TAHAL--Water Planning for Israel, Ltd., Tel Aviv (Israel).
For primary bibliographic entry see Field 2F.
W82-05644

EVIDENCE FOR A SHALLOW HIGHLY-PERMEABLE ZONE IN THE CHALK OF HAMPSHIRE, U.K.,
Southern Water Authority (England).
For primary bibliographic entry see Field 2F.
W82-05645

CHEMICAL CONSTRAINTS OF GROUNDWATER MANAGEMENT IN THE YUCATAN PENINSULA, MEXICO,
Geological Survey, Reston, VA.
W. Back, and J. M. Lesser.
Journal of Hydrology, Vol 51, No 1-4, p 119-130, May, 1981. 25 Ref.

Descriptors: *Water management(applied), *Groundwater management, Chemical properties, History, Geologic formations, Geohydrology, Groundwater pollution, *Geochemistry, Limestone, Solubility, Karst, Salinity, *Mexico(Yucatan Peninsula), Aquifer management.

Throughout its history, the cultural and economic development of the Yucatan Peninsula in Mexico has been significantly affected by the management of water resources. At present, the two critical objectives for groundwater management in the Yucatan are the development of regional groundwater supplies to meet the increasing demands of the expanding populations and the growing tourist industry in the area and the control of groundwater pollution in this chemically sensitive system made critically vulnerable by climate and geologic conditions. The chemical character of the groundwater of the Yucatan is largely controlled by the mixing of rain water with the sub-surface salt water, the solution of limestone and gypsum, and contamination by organic material and sewage. Although the peninsula is a coastal plain underlain by permeable limestone and has an annual rainfall of over 1,000 millimeters, which should provide abundant supplies of water, factors of climate and hydrogeology have combined to form a hydrologic system in which fresh water is scarce and whose chemical environment further decreases that restricted supply. Many wells have recently had to be abandoned due to serious pollution problems resulting from the use of sewage disposal wells adjacent to supply wells. The Secretaria de Recursos Hidraulicos has been charged with responsibility for scientific investigations and development programs for water supply and sewage disposal systems for the region since 1959. Several studies have been undertaken, water supply problems have been resolved so that cities and towns generally have safe water supplies, and sewage treatment and disposal programs are being developed. (Carroll-FRC)
W82-05650

AN ENRICHED FINITE ELEMENT FOR SIMULATION OF GROUNDWATER FLOW TO A WELL OR DRAIN,
Wright State Univ., Dayton, OH. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-05652

THE LIKELIHOOD OF ACTIVE GROUNDWATER RECHARGE IN THE BOTSWANA KALAHARI,
Institute of Geological Sciences, Wallingford (England). (United Kingdom).
S. S. D. Foster, A. H. Bath, J. L. Farr, and W. J. Lewis.
Journal of Hydrology, Vol 55, No 1/4, p 113-136, 1982. 10 Fig, 2 Tab, 28 Ref.

Descriptors: *Groundwater recharge, *Infiltration, *Excess rainfall, Recharge, Kalahari Desert, Africa, *Botswana, Kweneng, *Sands, Groundwater mining, Geohydrology, Pore water, Rainfall, Evaporation, Dating, Groundwater, Semiarid lands.

Groundwater resources were investigated in the Kalahari, covering over 2.5 million sq km of southern Africa with surface sands up to 9 m deep. This region is virtually devoid of surface water. Samples of soil and rock were collected by drilling to determine the geological and physical properties and the chemical and isotopic character of the interstitial water. Evidence indicates that in the study region, the Kweneng, which has a mean annual rainfall of 450 mm, diffused groundwater recharge is unlikely where sand cover is more than 4 m deep. Any short term excess rainfall is stored in the sands and used by vegetation or evaporated. Tritium and radiocarbon analysis of the groundwater being used in this area indicated ages of 2000-4500 years for some samples and over 10,000 years for others. These correspond with the two most recent pluvial eposides in the Kalahari, 750-2500 and 13,000-18,000 years ago. Therefore, it must be assumed that groundwater wells in this area are tapping unreplenishable supplies, unless the presence of deep aquifers and sand-free tracts can be confirmed. (Cassar-FRC)
W82-05657

POTENTIAL FOR GROUNDWATER RECHARGE SEEPAGE FROM FLOOD-RETARDING RESERVOIRS IN SOUTH CENTRAL NEBRASKA,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. E. Eisenhauer, D. M. Manbeck, and T. H. Stork.
Journal of Soil and Water Conservation, Vol 37, No 1, p 57-60, January/February, 1982. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Groundwater recharge, *Reservoirs, *Seepage, Recharge, *Nebraska, Big Blue River Basin, Runoff, Irrigation, Hydrologic budget, Aquifers, Water conservation.

Seepage rates at two flood control reservoirs in Nebraska's Upper Blue River Basin were monitored April through November 1975-77 to determine their contribution to groundwater recharge. Average seepage rates for the 1000 acre reservoirs were 0.50 inch per day and 0.59 inch per day at the Clay County site and the York County site, respectively. Average annual seepage volumes were 53 acre-feet at the Clay site and 92 acre-feet at the York site. Although the sum of the volume of outflow and seepage was nearly equal for both sites, about 130 acre-feet per year, the York County reservoir was more conducive to seepage because its surface area at high water levels was greater. It is possible to use reservoirs for groundwater recharge in the Great Plains, but the method is less feasible west of the study area. In the more arid regions there is less surface water and evaporation rates are higher, requiring more efficient recharge systems. (Cassar-FRC)
W82-05663

INDUSTRY HELPS CONSERVE MUNICIPAL WATER,
Anderson-Nichols and Co., Inc., Providence, RI.
For primary bibliographic entry see Field 3E.
W82-05674

DETERMINATION OF AQUIFER PARAMETERS USING REGRESSION ANALYSIS,
Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-05734

PHYTOPLANKTON RESPONSES TO GROUND WATER ADDITION IN CENTRAL FLORIDA LAKES,
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 5C.
W82-05747

HOW PROPER PROSPECTING IMPROVES THE ODDS,
International Reference Center for the Community Water Supply, the Hague (Netherlands).
For primary bibliographic entry see Field 3B.
W82-05757

THE RELATIONSHIP BETWEEN 018 AND DEUTERIUM IN WATER IN SAND COLUMNS UNDERGOING EVAPORATION,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W82-05759

WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES AT FORT MACKAY, ALBERTA,
Northern Illinois Univ., DeKalb. Dept. of Geology.
D. A. Hackbarth.
Canadian Water Resources Journal, Vol 5, No 1, p 87-99, 1980. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Tidal effects, *Water level fluctuations, *Well hydraulics, Groundwater movement, Fort MacKay, Alberta, Confined aquifers, Aquifers, Gravity waves, Statistical analysis, Tides, Hydraulics, Geohydrology.

Diurnal water level fluctuations were observed in a 315 m deep well, stratigraphically the lowest in a network of 90 wells in the Athabasca Oil Sands area. The well is completed fractured Devonian rocks. Overlying and underlying the water source are rocks of low permeability. The pressure head is well above the top of the aquifer. Statistical analysis indicated that barometric pressure was not a factor. However, autocorrelation of tidal-gravity corrections and water level fluctuations showed periods of 24.2 and 24.7 hours, respectively. Cross-correlation of residual water level and total gravity showed a period of 24.2 hours. Ratios of the wave amplitudes of tidal-gravity corrections and residual water levels were essentially constant. A semidiurnal wave did not appear to be present. In this well a 6-hour time lag was observed. This was caused by the slow response of the water to pressure changes in the aquifer and by the high total dissolved solids levels, 240,000 mg ep per liter. All evidence confirmed that the water level fluctuations were a result of earth tides. (Cassar-FRC)
W82-05780

AQUIFER MANAGEMENT IN DADE COUNTY,
Dade County Dept. of Environmental Resources Management, Miami, FL. Environmental Planning Div.
For primary bibliographic entry see Field 5G.
W82-05784

GROUND-WATER CONTAMINATION DUE TO VANISHING AND FINITE-SIZE CONTINUOUS SOURCES,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 5B.
W82-05799

THE ORIGIN OF HIGH IRON CONCENTRATIONS IN GROUNDWATER FROM THE TRIASSIC AQUIFER IN EAST DEVON,
Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 2K.
W82-05801

THE HYDROGEOLOGICAL BASIS FOR A WATER SUPPLY TO KABWE, ZAMBIA,
Aspinwall Hydrotechnical Services Ltd. (England), (United Kingdom).
J. F. T. Houston, and M. J. Morrey.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 27-42, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Hydrogeology, *Aquifer characteristics, *Groundwater mining, Water quality, Well yield, Water supply, Kabwe, *Zambia, Drilling, Groundwater recharge, Recharge, Groundwater availability, Groundwater budget, Groundwater management.

Results of a feasibility study for groundwater exploitation of the Dolomite Aquifer near Kabwe, Zambia, are reported. The investigation involved exploration, drilling, pump testing, and ancillary studies. The exploration phase used aerial photographs and resistivity depth soundings. In the drilling phase three types of boreholes were used: two NX-sized cored boreholes of 150 m depth to quantify fissure frequency and to locate the aquifer base and 21 150 mm percussive rotary boreholes to define the aquifer's extent and to find sites for the seven 300 mm rotary test production boreholes. Pumping tests were undertaken on the 150 mm boreholes, and the test production boreholes were tested with a turbine pump. Other tests included electric and gamma logs, fluid conductivity and temperature logs, and groundwater analysis. The aquifer base is about 80 m deep, and the dolomite formation 150 m. Transmissivity values are 200-500 sq m per day in the northeast, more than 1000 sq m per day over most of the aquifer, and up to 3500 sq m per day in areas of localized fissure development. Specific yield is 0.14 on the average. Waters are dominated by Ca-Mg-carbonate-bicarbonate ions and have 500 mg per liter total dissolved solids. The upper 20 m section of the dolomite has lower conductivity than the deeper layer. Annual precipitation recharge during 1965-80 was 26-771 mm in short vegetation areas and 0-534 mm in open forest. Subsurface recharge from the surrounding schist varies between 500 and 1200 cu m per day per km of boundary. Current demands on the Dolomite Aquifer are 55 Ml per day, total annual recharge 50-70 Ml per day. Recommendations for best development of the well field include new boreholes to spread abstraction over a wider area and to reduce the present pumping from the Kalulu well field. (Cassar-FRC)
W82-05804

CAPE COD AQUIFER, CAPE COD, MASSACHUSETTS,
Geological Survey, Providence, RI.
For primary bibliographic entry see Field 2F.
W82-05807

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1979 TO SPRING 1980.
Geological Survey, Tucson, AZ. Water Resources Div.
Geological Survey Open-File Report 81-906 (WRI), July 1981. 2 Plates, 25 Ref.

Descriptors: *Maps, *Groundwater, *Water level, *Pumpage, *Drawdown, Water level fluctuations, Irrigation, Water yield, Groundwater availability, Water supply, *Arizona.

Withdrawal of ground water, about 4.0 million acre-feet in Arizona in 1979, is about 200,000 acre-feet less than the amount withdrawn in 1978. The withdrawals in 1978 and 1979 are the smallest since the mid-1950's except in 1966. Nearly all the decrease was in the amount of ground water used for irrigation in the Basin and Range lowlands province. The large amount of water in storage in the surface-water reservoirs, release of water from the reservoirs, floods, and conservation practices contributed to the decrease in ground-water use and caused water-level rises in the Salt River Valley, Gila Bend basin, and Gila River drainage from Painted Rock Dam to Texas Hill. Two small-scale maps show ground-water pumpage by areas and the status of the ground-water inventory in the State. The main map, which is at a scale of 1:500,000, shows potential well production, depth to water in selected wells in spring 1980, and change in water level in selected wells from 1975 to 1980. A brief text summarizes the current ground-water conditions in the State. (USGS)
W82-05826

4C. Effects On Water Of Man's Non-Water Activities

SEASONAL STREAM TEMPERATURE CHANGES FOLLOWING FOREST HARVESTING,
Pennsylvania State Univ., University Park. School of Forest Resources.
G. B. Rishel, J. A. Lynch, and E. S. Corbett.
Journal of Environmental Quality, Vol 11, No 1, p 112-116, January-March, 1982. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Forest management, *Water temperature, Streams, *Clear-cutting, Cutting management, Forest watersheds, Herbicides, *Seasonal variations, Diurnal distribution.

Changes in water temperature of small, headwater streams were documented following a clearcut-herbicide treatment and a commercial clearcut harvest. The study site was the Leading Ridge Watershed Research Unit about 24 km southwest of State Collete, Pennsylvania. The unit is comprised of three adjacent watersheds that are representative of about 4.0 million ha of Pennsylvania forest. The clearcut herbicide treatment exposed the entire stream channel to direct solar radiation. The average maximum monthly stream temperature increase was 4.4 degrees C. Stream temperatures above 21 degrees C occurred nearly every day during the summer. Temperatures above 25 C were recorded as early as May. Highest stream temperature recorded was 32 degrees C, while on a control watershed stream water temperatures rarely exceeded 20 degrees C. Minimum stream temperatures were as much as 3.9 degrees C lower during the fall and winter months. Diurnal fluctuations also increased, being as high as 17 degrees C, compared to only 4 degrees C on non-treated watersheds. On an adjacent commercially clearcut watershed a buffer zone was left along the perennial stream channels, and only slight changes in stream temperature were noted. (Baker-FRC)
W82-04870

AN EVALUATION OF THE URBAN DESIGN STORM CONCEPT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-04960

FAMILY LIFE CYCLE DISRUPTION IN RURAL COMMUNITIES: THE CASE OF THE LAKE SHELBYVILLE RESERVOIR,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
R. E. Roper, and R. J. Burdge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224551, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 166, 102 p, 6 Fig, 4 Tab, 288 Ref. OWRT B-131-ILL(1). 14-34-0001-0218.

Descriptors: *Social impact, *Assessments, *Land acquisition, *Commercial farming, Ethnography, Personal and family life-cycles, Developmental cycles, Career contingencies, *Reservoirs, Construction, Anthropology, *Illinois, Lake Shelbyville, *Rural areas.

This project, assessed on an ex post facto basis, selected impacts upon families and individuals due to the land acquisition program associated with the construction of the Shelbyville Reservoir in east-central Illinois begun in 1962. Research focused on Okaw Township, which borders Lake Shelbyville to the west in Shelby County. The in-depth, individual and family case studies indicated that farm family businesses are not the products of a single generation, or a single family. They are intimately tied to the intergenerational land transfer process which occurs among interconnected families living in close proximity. Thus, the time perspective in examining changes brought about by land acquisition and relocation must be extended on the generational level if the full range of impacts on the local cultural ecology is to be represented. Areawide changes in the impacts on the local cultural ecology is to be represented. Areawide changes in the availability and price of land made the difficult task of reestablishing a family farm even harder for selected families. The Corps' land acquisition policies in 1962 did not consider the generations involved in the establishment of family farms. Furthermore, local residents were critical of the Corps' policies and personnel during the land acquisition process. That historical complaint summarized by the quote, 'the Corps is not a good

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neighbor,' has even today hindered the Corps' ability to manage its relations with area residents and local government units. An understanding of the personal and family life-cycle perspectives on local cultural ecology, coupled with an appreciation of the degree to which rural social processes are bound in time, can strengthen State of Illinois comprehensive planning, decision-making, and review procedures for water and related resource development.
W82-04966

SAWMILL BROOK: AN EXAMPLE OF RAPID GEOMORPHIC CHANGE RELATED TO URBANIZATION,
Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
C. L. Arnold, P. J. Boison, and P. C. Patton.
Journal of Geology, Vol 90, No 2, p 155-166, March, 1982. 11 Fig, 1 Tab, 24 Ref.

Descriptors: *Urbanization, *Geomorphology, Brooks, Channels, Watersheds, Runoff, Erosion, *Sediment transport, Sedimentation, *Environmental effects, Sawmill Brook, *Connecticut.

The effects that urbanization can have on stream pattern morphology are documented. Such observations can lead to a deeper understanding of the complex-response that can occur in the sediment transport regime as basin-wide sediment yields decline and stream runoff increases. The study area was Sawmill Brook, a tributary of the Mattabesset River, which drains a small watershed in central Connecticut on the northwest fringe of Middletown. Changes in land use were documented by comparison of sequential topographic maps and aerial photographs and from direct field observations. The southern headwater region of the basin has remained forested for the past 45 years. Within the study area reapportionment of agricultural and urban land use took place during 1934 to 1975. Urban development has included a large industrial park, several residential subdivisions, and the construction of an interstate highway through the basin. Associated with this development has been the major alteration of the drainage system in the lower portion of the basin. Runoff from the interstate highway and a portion of the industrial park has been funneled into Fall Brook, which has also been channelized to its confluence with Sawmill Brook. An increased frequency of flooding may be considered the result of short term climatic fluctuations, producing a change in precipitation. The increased frequency of moderate floods, the channel widening, and the change in the sediment transport regime is causing a change from a meandering to a braided channel pattern. With continued urbanization of the basin the present disequilibrium of the channel will be enhanced, resulting in an unstable channel pattern for Sawmill Brook. (Baker-FRC)
W82-05276

THE EFFECTS OF LAND-CLEARING ON A SMALL WATERSHED IN SOUTHERN GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5C.
W82-05303

LIFE HISTORY AND HABITAT UTILIZATION OF CUTTHROAT TROUT (SALMO CLARKI) IN A HEADWATER STREAM ON THE OLYMPIC PENINSULA, WASHINGTON,
For primary bibliographic entry see Field 5C.
W82-05306

MODIFICATIONS TO STEAM CHANNELS IN THE BRISBANE METROPOLITAN AREA, AUSTRALIA,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 4A.
W82-05572

RUN-OFF AND INFILTRATION LOSSES RELATED TO SHIFTING AGRICULTURE (JHUM) IN NORTHEASTERN INDIA,
Northeastern Hill Univ., Shillong (India). Dept. of Botany.
O. P. Toky, and P. S. Ramakrishnan.
Environmental Conservation, Vol 8, No 4, p 313-321, Winter, 1981. 10 Fig, 6 Tab, 21 Ref.

Descriptors: *Agricultural hydrology, *Runoff, *Nutrients, Infiltration, India, Percolation, Clearcutting, Vegetation effects, Minerals, Hydrologic cycles, Geochemistry, Fallowing, Monsoons, Jhum agriculture.

In northeast India shifting cultivation (Jhum) involves clearcutting the forest, during the dried biomass, and mixed cropping for 1 or 2 years, followed by a fallow period. In recent times the desirable 20-30 year cycle has been shortened to 4-5 years. Similar freshly-burned fields under 30, 10, and 5 year Jhum cycles and forested fallows of 5 and 10 years regrowth were studied. Nutrients were lost through ash and runoff in all cycles. More ash was liberated and more ash blew away in the 30-year cycle field than in the 5-year cycle field. Calcium losses were high in the 30-year cycle field (broad-leaved trees) and potassium losses were high in the 10-year cycle field (bamboo). Burning also released nutrients (C, N, and S) through volatilization. Runoffs (in cm) during the monsoon period (total 142 cm precipitation) in 1978 were: 5-year, 26.6; 10-year, 33.9; 30-year, 29.4; 5-year fallow, 26.9; and 10-year fallow, 18.5. Sediment losses were 22.5-30.0 tons per ha per year, increasing with shortening of the Jhum cycles, and about 1 ton per ha per year in the 5 and 10-year fallow fields. Percolated water losses were 14-18 cm for the 10 and 30-year Jhum cycles and the 10-yea fallow, and 21-23 cm for the 5-year fallow and 5-year Jhum cycle. Nutrient losses were 5-60 time higher, depending on the mineral, under the three Jhum cycle regimes than in the 10-year fallow. Shortening the Jhum cycle to 4-5 years has adversely affected the vegetation cover and the biological, geochemical, and hydrologic cycles. (Cassar-FRC)
W82-05573

PRELIMINARY MODEL OF AN URBAN FLOODPLAIN UNDER CHANGING LAND USE,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
D. P. Smith, and P. B. Bedient.
Journal of Hydrology, Vol 51, No 1-4, p 179-185, May, 1981. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Flood plains, *Urban areas, *Land use, Mathematical models, *Urban watersheds, Urbanization, Flood hydrographs, Detention reservoirs, Design criteria, Flood control, Storm runoff, Brays Bayou, Houston, *Texas.

The hydrologic response of Brays Bayou, a rapidly developing watershed in southwest Houston, was simulated by a computer model using the U.S. Corps of Engineers HEC-1 flood hydrograph package. Existing drainage specification and topographic maps were used to delineate six subwatersheds, while aerial photography was used to reveal current land-use patterns. The modeling effort was designed to predict the effect of urbanization on the runoff pattern of the basin and to test various storm water management alternatives. Unit responses of the six individual subcatchments were generated as functions of various basin parameters and of the extent of urbanization. Several historical storm events at four separate gauges within the Brays watershed were used to calibrate the hydrologic model. The detention storage capacities in the less developed subwatersheds were simulated by placing a reservoir at the outlet of each subwatershed. Detention storage was defined as the additional storage necessary to reduce the peak discharge downstream to a level below the capacity of the channel. A variety of rainfall patterns of different durations and intensities were used to determine the design detention storage for each subwatershed. Land uses were simulated for present conditions and for various development possibilities. Application of the model showed that full-scale development of the Upper Brays Bayou can be expected to overload a flood control system designed to handle the 100-year storm. The current drainage network has been found to be inadequate. Temporary on-site detention of runoff in the upper basin is recommended. (Carroll-FRC)
W82-05642

A REVIEW OF CATCHMENT EXPERIMENTS TO DETERMINE THE EFFECT OF VEGETATION CHANGES ON WATER YIELD AND EVAPOTRANSPIRATION,
Jondershoek Forestry Research Station, Stellenbosch (South Africa).
J. M. Bosch, and J. D. Hewlett.
Journal of Hydrology, Vol 55, No 1/4, p 3-23, 1982. 3 Fig, 2 Tab, 75 Ref.

Descriptors: *Forest hydrology, *Water yield, *Vegetation effects, *Reviews, Land use, *Catchments, *Evapotranspiration, Forest watersheds, Forest management, Clearcutting, Afforestation.

A summary and review of 94 catchment experiments throughout the world revealed several general conclusions on the effects of vegetation changes on water yield. Paired, nested, or grouped catchment experiments produced stronger evidence than less-controlled studies. Results of Hibbert's 1967 review of 39 catchment studies were little changed by the addition of results from 55 more recent investigations. The additional evidence strongly supported his first two generalizations-- (1) reduction of forest cover increases water yield, and (2) establishment of forest cover on sparsely vegetated land decreases water yield. However, the third generalization-response to treatment is highly variable, and for the most part, unpredictable-was not well supported. The present review indicates that vegetation has an influence on water yield as follows: coniferous forest > deciduous hardwood > brush and grass. Changing cover type by 10% produces the following changes in water yield: coniferous and eucalyptus, 40 mm; deciduous hardwoods, 25 mm; and brush and grasslands, 10 mm. Yield changes are greatest in high-rainfall areas, and the effect of clearcutting is shorter-lived than in low-rainfall areas. The annual changes due to treatment in high-rainfall areas are independent of rainfall variation from year to year, but dependent in low-rainfall areas. In low-rainfall areas recovery of water yields is slow because vegetation cover is slow to reestablish. The highest water change in any study was 660 mm per year (relative to bare ground) reported in the Coweeta catchment, North Carolina, where a mixed hardwood forest was 100% clearcut in 1941, regrowth was cut annually, and the area was 100% planted with pine in 1956. (Cassar-FRC)
W82-05647

STORM RUNOFF FROM SMALL LOWLAND CATCHMENTS IN SOUTHWEST ENGLAND,
Imperial College of Science and Technology, London (England).
H. S. Wheater, T. L. Shaw, and J. C. Rutherford.
Journal of Hydrology, Vol 55, No 1/4, p 321-337, 1982. 12 Fig, 2 Tab, 8 Ref.

Descriptors: *Storm runoff, *Urbanization, *Flood peak, Rainfall-runoff relationships, Gloucester, *England, Hydrographs, Soil water, Catchments, Streamflow, Antecedent moisture.

Fifty-five storm runoff events (1970-74) in eight small lowland catchments with clay soils in southwest England were analyzed. Unit hydrograph shape was related to antecedent soil moisture, stream slope, and degree of urbanization. The storm runoff volume was related to soil moisture deficit and to storm rainfall. Dry catchments responded more rapidly to rainfall than wet catchments, with higher peak flow, shorter unit hydrographs, and increased time to peak. The proportion of urbanization was postively correlated with unit hydrograph flow peak and negatively correlated with time-to-peak, with little effect seen for wet catchments and very noticeable effects for dry catchments. Unit hydrograph peak flow increased with channel slope and was negatively correlated with total rainfall volume. Unit hydrograph lag was positively correlated with catchment length and negatively correlated with slope and degree or ubanization. Rainfall loss was independent of

catchment morphology and depended on total rainfall volume and antecedent soil moisture deficit. (Cassar-FRC)
W82-05653

SUBSURFACE FLOW VELOCITIES THROUGH SELECTED FOREST SOILS, SOUTH ISLAND, NEW ZEALAND,
Forest Research Inst. Christchurch (New Zealand).
M. P. Mosley.
Journal of Hydrology, Vol 55, No 1/4, p 65-92, 1982. 7 Fig, 6 Tab, 26 Ref.

Descriptors: *Subsurface flow, *Flow velocity, Forest hydrology, Forest soils, *New Zealand, Tawhai Forest, Big Bush Forest, Craigieburn Forest, Streamflow, Soil water, Antecedent moisture, Hydrology, Soil saturation, Soil porosity, Soil structure, Porosity, Permeability, Bedrock, Root zone, Rainstorms.

Subsurface flow through soils at a total of 51 locations in three New Zealand state forests was investigated by applying water upslope from a pit and determining mean and maximum flow velocities. Mean flow velocity and maximum flow velocity (both in cm per sec), respectively were: Tawhia Forest, undisturbed, 0.1-0.45 and 0.037- 0.67, logged/unburned, 0.020-0.79 and 0.049-2.08, and logged/burned/planted, 0.015-0.64 and 0.072-0.83; Big Bush Forest, 0.-0.93 and 0.055-1.67; and craigieburn Forest, beech forest, 0-0.98 and 0.072-1.67, tussock sites, 0-0.22 and 0.074-0.48. Coefficients of variation were large. There was no significant difference in results from the three different land treatments in Tawhia Forest. Factors affecting subsurface flow were antecedent moisture conditions, soil properties, macropore network, and parent material at the base of the soil. The macropore network was less important in determining hydrological behavior in open-structured soil with a permeable parent material than in less open-structured soil over impermeable bedrock. In Tawhia Forest saturation of the lower soil layers regularly occurs, so that rapid flow through macropores is common and many reach 40% in a small 3-hour storm and 100% in moderate to large rain events. At Big Bush, with less soil moisture and longer slopes, rapid subsurface flow is likely to reach the stream only during larger and longer storms. Craigieburn's drier, deeper soils and permeable underlayer allow less subsurface flow to reach streams during the storm period. (Cassar-FRC)
W82-05712

SLASH BURNING EFFECTS ON SOIL AND WATER CHEMISTRY IN SOUTHEASTERN ALASKA,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. D. Stednick, L. N. Tripp, and R. J. McDonald.
Journal of Soil and Water Conservation, Vol 37, No 2, p 126-128. March/April, 1982. 1 Fig, 3 Tab, 24 Ref.

Descriptors: *Water quality, *Forest fires, *Soil chemistry, *Alaska, Forest management, Forest soils, Nutrients, Water pollution sources, Erosion.

Timber harvest followed by slash burning in the coastal hemlock-spruce forests of Chicagof Island in southeastern Alaska did not produce significant long-term effects on soil or water resources. A 13 ha site, logged in 1977 and burned in June 1978, was monitored by collecting daily stream water samples from above and below the burn during the snow-free months of 1978 and 1979. Soil samples were also analyzed. Suspended sediment levels were higher in the water below the burn (116.8 mg per liter) than above the burn (35.4 mg per liter). Fourteen of the 16 water quality parameters were not significantly different when above-burn and below-burn sample results were compared. However, total P and K levels were higher in below-burn stream water. In soil samples slash burning produced no significant differences in litter depth, pH, N, P, and Ca levels. However, K and Mg concentrations in the burned soil were about half of the control concentrations. (Cassar-FRC)
W82-05715

NORTHWESTERN ONTARIO RIVER DIMENSIONS,
Simon Fraser Univ., Burnaby (British Columbia).
For primary bibliographic entry see Field 6G.
W82-05742

TOTAL SUSPENDED SOLIDS IN HIGHWAY RUNOFF IN WASHINGTON STATE,
RH2 Engineering, Seattle, WA.
For primary bibliographic entry see Field 5B.
W82-05820

4D. Watershed Protection

EROSION BY PLANE TURBULENT JETS,
Alberta Univ., Edmonton.
For primary bibliographic entry see Field 8B.
W82-05277

A PARAMETRIC MODEL TO ESTIMATE RUNOFF FROM SMALL AGRICULTURAL WATERSHEDS IN THE SEMI-ARID TROPICS,
International Crops Research Inst. for the Semi-Arid Tropics, Patacheru (India).
For primary bibliographic entry see Field 2E.
W82-05646

DRYLAND SALINITY IN A CLOSED DRAINAGE BASIN IN NOBLEFORD, ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and D. C. MacKay.
Journal of Hydrology, Vol 55, No 1/4, p 25-41, 1982. 7 Fig, 3 Tab, 16

Descriptors: *Drainage, *Closed basins, *Saline soils, Nobleford, *Alberta, Canada, Soil water, Ecological effects, Water management, Land use, Vegetation effects, Fallowing, Range grasses, Cropland.

Factors causing dryland salinity near Nobleford, Alberta, were defined during a 1972-77 study on a site forming a 650 ha dome, which contained a closed basin. Although salinity in the basin was not evident in 1938, two small seeps had appeared by 1954. More than 50 ha of land was salinized by 1973. Studies of well data, precipitation records, rock and soil profiles, snow drifting, and water analysis results indicated that the salinity problems in this basin were a result of disturbances of the natural ecosystem. Native range had been replaced by cereal cropping and summer fallow. Natural drainage patterns had been changed by snow and water retainers and drainage of runoff into the basin. Also contributing to the salinity condition were natural conditions--shallow bedrock in the recharge area, fine soil in the lowland, depressions in bedrock under certain areas, and lack of surface drainage from the basin. Corrective measures are based on discouraging water access in the basin, discontinuing summer fallow, continuous cropping, growing perennial forage crops, removing snow and water retainers, and removing accumulated water from the basin for use in irrigation. (Cassar-FRC)
W82-05656

EROSION CONTROL POTENTIAL WITH CONSERVATION TILLAGE IN THE LAKE ERIE BASIN: ESTIMATES USING THE UNIVERSAL SOIL LOSS EQUATION AND THE LAND RESOURCE INFORMATION SYSTEM (LRIS),
Ohio State Univ., Columbus. Dept. of Agronomy.
T. J. Logan, D. R. Urban, J. R. Adams, and S. M. Yaksich.
Journal of Soil and Water Conservation, Vol 37, No 1, p 50-55, January/February, 1982. 1 Fig, 8 Tab, 12 Ref.

Descriptors: *Erosion control, *Phosphorus, *Water pollution control, *Lake Erie Basin, *Soil erosion, Cropland, Soil conservation, Cultivation, Soil management, Watershed management, *Cultivation.

Soil loss in the U.S. Lake Erie drainage basin was estimated using the Universal Soil Loss Equation and the U.S. Army Corps of Engineers Land Resources Information System (LRIS). Average annual soil loss was 2.2 tons per acre, with a range of 0.4 to 4.4 tons per acre for individual watersheds. Highest soil losses were in the western and central basins. Basins with the greatest soil losses were the Raisin (Michigan); Maumee, Sandusky, Huron, and Vermilion (Ohio); and Cattaraugus (New York). These watersheds have fine-medium glacial-till derived soils and are highly cultivated, except for the Cattaraugus watershed, which has steep slopes. Reducing soil loss to the tolerance level in all cases would reduce soil loss in the basin as a whole by 40%. The conservation tillage method and the maximum conservation tillage method would reduce soil loss by 46% and 69%, respectively. Methods which made little difference in soil loss were spring plow only and winter cover. Fall plow only actually increased soil loss by 7%. Since a 75% reduction in mean soil loss is necessary to reduce diffuse source phosphorus loads by 50%, none of these methods alone can accomplish this goal. (Cassar-FRC)
W82-05661

WATER YIELD ESTIMATION IN WESTERN UNITED STATES,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, and R. H. McCuen.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 25-34, March, 1982. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Project planning, *Watershed management, *Water yield, Hydrologic models, *Statistical analysis, Mathematical studies, Precipitation(Atmospheric), Vegetation effects, Precipitation intensity, Model studies, Mathematical models, Statistical methods, Prediction, *Western US.

The mean annual water yield of a watershed is used in planning, managing and designing some watershed projects, especially irrigation projects. A statistical study of water yield data from 605 watersheds of noncoastal areas of the western United States was used to develop five equations to estimate the annual water yield of five distinct hydrologic regions. Empirical estimation coupled with regionalization was deemed the most practical method for estimating mean annual water yield. Separation of the study area into five regions significantly improved the accuracy of the estimation. Cluster analysis was used to define the five regions, and a linear mathematical model was developed which explained 57.95% of the variation of the mean annual water yield. The most important predictor of water yield in all regions was the mean annual precipitation, while other variables such as vegetation cover density and precipitation intensity explained smaller amounts of the total variation. (Geiger-FRC)
W82-05689

EROSIVITY VALUES FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 85-87, March, 1982. 1 Tab.

Descriptors: *Mathematical studies, *Error analysis, *Erosion control, *Storm runoff, *Soil conservation, Errors, Erosion, Soil erosion, Storms, Model studies, Mathematical models.

To address the questions raised about the magnitude of errors involved in calculating erosivity values for individual design storms, the value of EI/100 for storm volumes of 2 and 12 inches for durations from 0.5 to 24 hr and for each of four Soil Conservation Service (SCS) storm distributions was determined. The use of various figures in the original paper is explained. Normalizations in

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the original work provided better comparisons than did actual storm data of any duration, as compared to the 24-hr SCS distributions suggested by previous investigators. By using long periods of actual storm data, the frequency of storm types likely to occur at a site may be determined. The knowledge of frequency of occurrence of a given storm type may be used in designing soil conservation measures. (Geiger-FRC)
W82-05694

STREAM IMPROVEMENT: THE CHICOD CREEK EPISODE,
Soil Conservation Service, Greenville, NC.
A. Coffey.
Journal of Soil and Water Conservation, Vol 37, No 2, p 80-82, March/April, 1982. 6 Ref.

Descriptors: *Channel improvement, *Watershed management, *Legal aspects, Chicod Creek, North Carolina, Flood control, Sediment control, Environmental effects, Excavation, Monitoring, Fish, Wildlife, Water quality, Water law, Judicial decisions, Flood plain management.

Planned improvements to the clogged and flood prone Chicod Creek, North Carolina, were challenged in a lawsuit November 30, 1971, by a group of five local and national organizations. As a result the project was modified to minimize environmental impacts. Work started in November 1978. Major changes in plans were: wooded swamps were not excavated, only fallen trees and debris were removed; construction was shut down from February 1 to June 30 to avoid interference with herring spawning runs; sediment traps were constructed at critical points; 15 ft wide grass strips were established on banks in non-forested land; channels were excavated from one side only; spoil banks were placed 15 ft from the channel bank in critical areas and were seeded with stabilizing vegetation; clumps of trees were preserved at 200-300 ft intervals; and channel banks were sloped 1:1 except for some experimental areas with 2:1 and 3:1 slopes. Monitoring of fish and wildlife, water quality, and groundwater condition was started before construction and will continue until about 1986. As a result of this landmark suit, watershed planning has become more comprehensive and considerate of environmental values. (Cassar-FRC)
W82-05717

MODELING SEDIMENT YIELDS FROM AGRICULTURAL WATERSHEDS,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, L. F. Huggins, and E. J. Monke.
Journal of Soil and Water Conservation, Vol 37, No 2, p 113-117, March/April, 1982. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Agricultural watersheds, *Watershed management, *Sediment yield, Cultivation, Model studies, ANSWERS model, Indiana, Black Creek, Erosion control, Nonpoint source pollution, Soil conservation.

Distributed parameter models are potentially more accurate than lumped parameter models in estimating sediment yields. A distributed parameter model, ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) was applied to a 714-ha agricultural watershed in the Black Creek Basin, Indiana. Rainfall amount and total sediment yield were predicted within 13% of observed amounts. Simulation of sediment yield under different tillage practices showed that chisel plowing produced one-third less sediment than the prevailing practice, fall moldboard plowing. Closer examination of two small high-erosion sections, combined area 32 ha, showed that changing to chisel plowing only in these small sections would account for 40% of the sediment yield reduction that would be achieved if the entire watershed were chisel plowed. (Cassar-FRC)
W82-05718

UNIFIED RIVER BASIN MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6B.
W82-05769

BEDLOAD AND SIZE DISTRIBUTION IN PAVED GRAVEL-BED STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W82-05795

USING THE ANSWERS MODEL TO ESTIMATE SEDIMENT YIELDS ON CONSTRUCTION SITES,
Guam Univ., Agana. Water and Energy Research Inst.
T. A. Dillaha, III, D. B. Beasley, and L. F. Huggins.
Journal of Soil and Water Conservation, vol 37, No 2, p 117-120, March/April, 1982. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Sediment yield, *Construction, *Watershed management, ANSWERS model, Model studies, Erosion control, Runoff, Alternative planning, Land management, Soil conservation.

ANSWERS (Areal Nonpoint source Watershed Environment Rresponse Simulation), a disributed parameter model designed for use in agricultural watersheds, was used to evaluate solutions to runoff and erosion from construction activities. A residential development was being built in a 53-ha watershed with slopes of 0-17% in which 95% of the land had been used for row crops (corn), 15% trees, and 2% swampy lowlands. The design storm, 5.28 cm of rainfall within 1.5 hours, produced from 5,100 (chisel plowing) to 16,300 (fallow) kg per ha of sediment under the 12 tested alternatives. The agricultural conditions before development (corn) yielded 13,500 kg per ha. Construction by scalped topsoil with bare roadways, gravel roadways, or paved roadways yielded 16,000, 14,500, and 15,400 kg per ha, respectively. Scaled, but seeded and mulched areas with bare roadways or gravel roadways produced 12,700 and 9,800 kg per ha sediment, respectively. Land left as crop residues and weeds with bare roadways or gravel roadways reduced sediment losses to 11,500 and 6,900 kg per ha, respectively. The practice of scaled topsoil with bare roadways and sediment basisns or diversion structures allowed 13,800 and 15,500 kg per ha losses, respectively. Model results were consistent with the few available field observations at the construction site. (Cassar-FRC)
W82-05865

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COMPARISON OF VARIOUS BACTERIAL INDICATORS OF FECAL CONTAMINATION OF THE SEINE IN THE PARIS REGION (COMPARISON DE DIFFERENTS INDICATEURS BACTERIENS DE CONTAMINATION FECALE SUR LA SEINE EN REGION PARISIENNE),
Societe Lyonnaise des Eaux et de l'Eclairage (France).
M. Rizet.
Aqua, No 7, p 150-152, July, 1980. 1 Fig, 2 Tab. (English summary).

Descriptors: *Bacterial analysis, *Water quality, *Indicators, *Seine River, Paris, Feces, Coliforms, *Bioindicators, Variation coefficient, Mathematical studies, Water pollution, *Pollutant identification.

Water samples were collected approximately weekly at four potable water plant intakes in the Paris area and subjected to comparative bacterial counts. Fecal coliforms were counted on Chapman TTC medium, sulfite reducing clostridium (Clostridium perfringens) on Bacto SPS agar medium, and fecal streptococci on Stranetz and Bartley medium, in each case following concentration by membrane filtration. The maximum amplitudes of variation in bacterial counts between the two treatment plants farthest apart, based on the annual means, were 26 for fecal coliforms, 18 for fecal streptococci and 8 for clostridium. Thus the fecal coliform count seems to be the most sensitive of the three indicators investigated. Variations from the mean at a single point were 76% for fecal coliforms, 107% for fecal streptococci and 120% for clostridium. The bacterial as well as physical and chemical analyses of the Seine water demonstrated increasing deterioration of water quality from upstream to downstream of Paris. (Carroll-FRC)
W82-04763

BORON STATUS OF BERLIN WATERS (BORSTATUS BERLINER GEWASSER),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Okologie.
H. P. Blume, R. Bornkamm, T. Kempf, S. Muljadi, and F. Raghi-Atri.
Archiv fur Hydrobiologie, Vol 89, No 4, p 426-439, August, 1980. 4 Fig, 10 Tab, 17 Ref.

Descriptors: *Boron, *Lakes, *Chemical analysis, *Nutrients, Drinking water, *Berlin, Germany, Water pollution sources, Phosphorus removal, Chemical precipitation, Lime.

Boron is a micronutrient of widespread occurrence, which may be toxic to crops at higher concentrations. Substantial increases in boron contents of some German waterbodies have occurrent in recent years due to increased use of boron-containing fertilizers, pharmaceuticals, laundry bleaches, and other chemicals. The boron levels were investigated in the Tegeler See, Oberhavel, Heiligensee, and Pechsee, four lakes in the Berlin watershed. The Tegeler See receives wastewater effluents and is considered polluted. In 1975-76 the Tegeler See had a mean boron content of 0.2 mg/l; the Nordgraben, its principal feed stream, contained 0.6 mg/l. Boron contents in the Heiligensee and Pechsee were below 0.1 mg/l. Seasonal variations in the Tegeler See were small, while the large variations in the Heiligensee were attributed to occational occurrence of backup from the Havel as well as to biological binding and precipitation. Boron accumulations were also determined in the biocenosis and the sediment of the lakes. The present boron levels and rates of increase (ca. 5%/yr) appear to present no threat to drinking water quality if water is obtained from wells into which lake water infiltrates. Combined use of lime and iron chloride for phosphate removal from lake influents would have the side effect of removing most of the boron and heavy metals. (Carroll-FRC)
W82-04767

MYTILUS CALIFORNIANUS AS A BIOINDICATOR OF TRACE METAL POLLUTION: VARIABILITY AND STATISTICAL CONSIDERATIONS,
Moss Landing Marine Lab., CA.
M. Gordon, G. A. Knauer, and J. H. Martin.
Marine Pollution Bulletin, Vol 11, No 7, p 195-198, July, 1980. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Bioindicators, *Trace metals, Mytilus, Mussels, Water pollution, Pollutants, Indicators, Aluminum, Cadmium, Lead, Chromium, Iron, Nickel, Copper, Zinc, Aquatic populations, *Pollutant identification.

Mytilus californianus is a commonly used trace metal bioindicator species. This study investigated the natural variability of this mussell by analyzing specimens collected from two sites in the Southern California Bight for their aluminum, cadmium, chromium, copper, iron, nickel, lead, and zinc contents. Factors which can contribute to the observed population variability include water temperature, salinity, and with in-site variation. This variance should be minimized in order to maximize the ability to resolve differences in mean trace metal levels between populations in relation to a given independent variable. When M. californianus is used as the bioindicator, increases or decreases in metal concentrations on the order of 15 to 40 percent must occur if significant differences are to be detected by analyzing 30 individuals from each site. In general, analysis of between 10 and 30 individuals was required to yield maximum resolution in terms of trace metal concentration between population means while maintaining cost effectiveness. The number of samples required to detect a

given difference may vary from year to year or from site to site, necessitating the determination of population variance estimates for each collection site. The technique of pooling many individual organisms into a single sample may be used to increase resolution and reduce analytical load. However, a variability study using individual samples should still be used as the first step in any baseline or monitoring program. (Carroll-FRC)
W82-04776

APPARATUS NEEDS AND COSTS FOR MONITORING PRIORITY POLLUTANTS,
Ohio River Valley Water Sanitation Commission, Cincinnati.
A. H. Vicory, Jr., and J. F. Malina, Jr.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 125-128, February, 1981. 1 Fig, 5 Ref.

Descriptors: *Laboratory equipment, *Monitoring, *Water analysis, *Pollutant identification, Wastewater analysis, Priority pollutants, Organic compounds, Metals, Pesticides, Chromatoraphy, Costs.

This report, prepared by the Water Pollution Control Federation Toxic Substances Committee, described the equipment and resources needed for monitoring toxic materials in wastewater effluent and natural waters. Analysis of the 127 compounds on the priority pollutant list requires a gas chromatograph-mass spectrometer for organic and miscellaneous compounds (minimum $75,000), a purge and trap attachment for the chromatograph ($5500) for purgeable organics, equipment for base/neutral extractables ($2500), flame ionization detector or electron capture devices for the chromatograph to isolate acid-extractable organics ($4000), pesticide analysis equipment ($2500), and atomic absorption spectrophotometer and associated equipment (up to $20,000) and colorimetric apparatus (up to $6000) for metals and cyanides. A recently built 2600 sq ft facility for wastewater effluent analysis cost $250,000, excluding costs of land, utilities, and instruments. Operating costs including salaries for an analytical facility are a minimum of $100,000 per year. Analytical costs per sample range from $10 to $2000. Monitoring priority pollutants in natural waters requires a minimum investment of $30,000 for equipment and $10,000 annual operating costs based on 1 sample per day, 5 days per week. (Cassar-FRC)
W82-04779

RELIABILITY OF ANALYTICAL METHODS FOR ANAEROBIC MUNICIPAL SOLID WASTE SAMPLES,
Miami Univ., FL. Dept. of Mechanical Engineering.
E. L. Daly, Jr., and S. Farooq.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 187-192, February, 1982. 5 Fig, 4 Tab, 5 Ref.

Descriptors: *Chemical analysis, *Precision, *Solid wastes, *Pollutant identification, Heavy metals, Metals, Nitrogen compounds, Ammonia, Nitrates, Nitrites, Phosphorus, Chloride, Chemical oxygen demand, Sulfides, Anaerobic digestion, Municipal wastes.

Samples of anaerobically digested municipal refuse were spiked with 1 to 2.5 times the normal level of the constituent of interest to test the reliability of standard analtyical methods as described in 'Standard Methods' and EPA's Level One Assessment. Samples were spiked with a single chemical or a mixture of substances. Statistical analysis of the data showed that relative recoveries of singly-spiked substances were: total organic nitrogen, 93%; ammonia N, 84.1%; nitrite N, 119%; nitrate N, 44%; total phosphorus, 157%; chloride, 104%; COD, 70%; total organic carbon, 65%; sulfide, 80%; zinc, 86.1% calcium, 174%; iron, 86%; manganese, 75.1%; nickel, 88.5%; cobalt, 154%, cadmium, 56.7%; copper, 111%; and chromium, 101%. Recoveries for nearly two thirds of the 18 parameters were within the range 80-120%. Analytical precision was about 10% for most of the parameters analyzed. In the composite spike samples self-interferences produced recoveries from -0.11% to 502% in a distilled water matrix and -33.3% to 805% in an effluent filtrate matrix. These results emphasize the importance of conducting spiking experiments individually or with an appropriate control. (Cassar-FRC)
W82-04789

GAS-CHROMATOGRAPHIC SPECIATION OF METHYLSTANNANES IN THE CHESAPEAKE BAY USING PURGE TRAP SAMPLING WITH A TIN-SELECTIVE DECTOR,
National Bureau of Standards, Washington, DC.
J. A. A. Jackson, W. R. Blair, F. E. Brinckman, and W. P. Iverson.
Environmental Science and Technology, Vol 16, No 2, p 110-119, February, 1982. 8 Ffig, 3 Tab, 31 Ref.

Descriptors: *Chemical analysis, *Bays, Chromatography, Organotin compounds, Metabolism, Organometallic compounds, Photometry, Flame photometry, Tin, Heavy metals, *Chesapeake Bay, *Pollution identification.

A method is presented which permits detection and speciation of both volatile and nonvolatile organotin compounds in aqueous media. The method makes use of a commercial gas chromatograph with a flame photometric detector optimized for tin-selective detection. The purge volatiles and species volatilized by hydridization with NaBH4 were concentrated by a commercial automatic purge and trap sampler employing a Ttenax-GC filled trap. Varying amounts of methyltin compounds were detected by the method, including tetramethyltin and methyltin hydrides, in polluted sites in Baltimore Harbor. Gas chromatography-mass spectrometry was used to confirm earlier reports of microbial methylation of inorganic tin by a strain of Pseudomonas isolated from the Chesapeake Bay. Biogenic origins are thus suspected for the methylstannanes found in the Bay area. (Baker-FRC)
W82-04808

GROUNDWATER MONITORING,
For primary bibliographic entry see Field 6E.
W82-04809

ANODIC STRIPPING VOLTAMMETRY AS AN ANALYTICAL TOOL,
New Mexico State Univ., Las Cruces. Dept. of Chemistry.
J. Wang.
Environmental Science and Technology, Vol 16, No 2, p 104A-109A, 1982. 2 Fig, 1 Tab, 50 Ref.

Descriptors: *Heavy metals, *Water analysis, Measuring instruments, *Anodic stripping voltammetry, Pollution load, Monitoring, Water quality, Water pollution control.

Anodic stripping voltammetry has been used extensively to analyze natural water samples. Beginning in the 1970s ASV has been widely used for analyzing about 20 trace metals in different types of natural waters such as oceans, lakes, rivers, and sewage and industrial effluents, along with tap water. The more sensitive version of ASV, involving the sensitive differential pulse excitation ramp during the stripping step, is usually employed for measuring ultratrace concentration levels of some toxic metals such as thallium, lead, and cadmium in seawater and inland waters. The advantages of using ASV for measuring trace metals in natural water are the direct analysis capability, elimination of concentration steps, and minimum use of reagents. ASV is subject to many potential interferences due to the myriad of variances, such as surfactants, metals, and ligands present in natural waters. An important feature of ASV is its capability to differentiate various chemical forms of a given trace metal in solution, in contrast to atomic absorption or neutron activation, which measure the total metal content. (Baker-FRC)
W82-04811

ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WATER, WASTE WATER AND AN INDUSTRIAL EFFLUENT,
Imperial Coll. of Science and Technology. London (England). Public Health Engineering Lab.
P. Leinster, A. E. McIntyre, J. N. Lester, and R. Perry.
Chemosphere, Vol 10, No 3, p 291-301, March, 1981. 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Organic compounds, *Volatile compounds, *Industrial wastewater, Chlorinated hydrocarbons, Chloroalkanes, *Pollutant identification, Water analysis, Wastewater analysis, Extraction, Solvent extraction, Gas purging, Adsorption.

Three methods for removing volatile organic compounds from water samples prior to gas-liquid chromatographic analysis were evaluated. These methods were solvent extraction, gas sparging, and closed-loop stripping. Water samples spiked with a mixture of n-chloroalkanes (C8-C18) were used as standards. Using dichloromethane as an extraction solvent, chloroalkane recoveries were 42-66%, increasing with increasing alkly chain length. Hexane, cyclohexane, and diethyl ether recovered 20-45% of the chloroalkanes. In the gas sparging technique, recovery of organics increased with increasing helium volumes from 2 to 12 liters. Recovery decreased with increasing chloroalkane chain length from 65%-100% at C8 to < 20% at C18. A 55 C sparging temperature gave better recovery than 30 C and 21 C from C8 to C14. Recovery at all three temperatures decreased to about 10% at C18. Closed-loop stripping for 40 hours completely recovered C8 to C12 chloroalkanes but only 10-70% of the higher alkanes. Recoveries of all compounds increased with temperature, especially the higher molecular weight materials. Analysis of a trade effluent containing high levels of volatile organic compounds, sewage, sewage effluents, river water, and air samples after using each of the three extraction methods produced very different results. Each method removed a different porportion of the constituents. Solvent extraction with dichloromethane removed the widest range of compounds. It is likely that more than one extraction method must be used to obtain extensive information about the organic constituents of a water sample. (Cassar-FRC)
W82-04815

GAS CHROMATOGRAPHIC DETERMINATION OF PHENOLIC COMPOUNDS IN WATER, AS THEIR PENTAFLUOROBENZOYL DERIVATIVES,
Stockholm Univ. (Sweden).
L. Renberg.
Chemosphere, Vol 110, No 7, p 767-773, July, 1981. 2 Fig, 1 Tab, 23 Ref.

Descriptors: *Phenols, *Wastewater analysis, *Pollutant identification, *Gas chromatography, Water analysis, Organic compounds, Fluorobenzoylation.

Phenolic compounds in water and wastewater were determined by gas chromatography-mass spectrometry after conversion to the pentafluorobenzoyl derivatives and extraction into an organic solvent. No isolation step was necessary before the derivatization procedure. Test substances were phenol, 2,4-dimethylphenol, 4-chloro-2-cresol, 4-hloroe-e-cresol, 2-chlorophenol, 2,4-dichlorophenol, and 2-hydroxy-5-chlorodiphenylmethane. Precision of the method was 3.1-6.6% relative standard deviation. The method was linear within the 0.001 to 10 mg per liter range. Comparisons with the pentafluorobenzylation method showed that the pentafluorobenzoylation method was faster and had less background on the chromatogram. (Cassar-FRC)
W82-04816

PIXE TRACE ELEMENT ANALYSIS OF AN AQUATIC PLANT AS INDICATOR OF HEAVY METAL POLLUTION,
Tokyo Univ. (Japan).
A. Jahnke, T. Shimmen, H. Koyama-Ito, and T. Yamazaki.
Chemosphere, Vol 10, No 3, p 303-312, March, 1981. 3 Fig, 2 Tab, 16 Ref.

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Descriptors: *Bioindicators, *Heavy metals, *Algae, *Indicators, Metals, Trace metals, Water analysis, Chara corallina, Accumulation, Bioaccumulation, X-ray emission analysis, Aquatic plants, Pollutant identification, *Fate of pollutants.

Trace metals in water were determined by charged particle induced X-ray emission (PIXE) analysis of Chara corallina, a fresh water alga with large (1 cm x 1 mm), easily-located internodal cells. This alga accumulates metals in its cell walls. After 1 day incubation in water supplemented with 0.01 mM heavy metal ions, the algal cell walls concentrated metals by a factor as large as 1000. Cu, Zn, and Hg were preferentially accumulated. Other metals used in the study were Fe, Sr, Ba, Pb, Ag, and Cd. cu accumulation rates were greater in 0.1 mM solutions than in the lower concentrations tested. This alga is a useful indicator plant for heavy metals. (Cassar-FRC)
W82-04818

RECENT TRENDS OF BIOCIDES IN PIKES OF THE LAKE PAIJANNE,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, J. Sarkka, M. Aho, K. Surma-Aho, and J. Tarhanen.
Chemosphere, Vol 10, No 4, p 405-414, April, 1981. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Fish, *Mercury, *Chlorinated hydrocarbons, *Lake Paijanne, *Finland, *Pike, Methylmecury, Organic compounds, Insecticides, Pulp and paper industry, Phenols, Fate of pollutants, Pollutant identification.

Pike (Esox lucius) were sampled in May 1980 in three areas of Lake Paijanne, Finland, and analyzed for several pollutants. Average mercury levels were as follows: total Hg, 642 + or - 204 ng per g; and methylmercury, 83.21 + or - 11.11%. Other contaminants monitored were HCB, DDE, polychlorinated biphenyls, 2,4,6-trichlorophenol, 2,3,4,6-tetrachlorophenol, tetrachloroguaiacol, pentachlorophenol, and tetrachlorocatechol. Levels of these chemicals were variable. Although pentachlorophenol concentrations were 10-70 ppb (fresh weight) in all three locations of the lake, the other chemicals associated with pulp and paper manufacture were found in abundance only at Tiirinselka. Regression analysis of the current findings and previous results showed a decreasing trend in Hg levels in fish tissue from 1970 to the present. Curves were developed to predict Hg levels to 1984, based on the fact that Hg pollution of the lake stopped in 1968. (Cassar-FRC)
W82-04819

OCCURRENCE AND DETERMINATION OF ORGANIC OXIDANTS IN RIVERS AND WASTEWATERS,
Illinois Univ at Urbana-Champaign. Inst. for Environmental Studies.
R. A. Larson, K. Smykowski, and L. L. Hunt.
Chemosphere, Vol 10, No 11/12, p 1335-1338, November/December 1981. 1 Tab, 12 Ref.

Descriptors: *Organic compounds, *Oxidation, *Pollutant identification, *Wastewater analysis, *Raw water, Water analysis, Rivers, Iodometric methods, Disinfection, Chemical analysis.

A spectrophotometric iodometric method, using two concentration procedures, was used to detect organic oxidants in river water and wastewater. Examples of oxidants under consideration are chloramines, quinones, and hydroxyhydroperoxides. Recovery of two known peroxides indicated that the concentration method using ion exchange was 80-85% efficient, and dichloromethane extraction, 70-82% efficient. Organic oxidants were detected in water samples as follows: Henry, Illinois, municipal wastewater, 2.5 times 10 to the minus 5th power M; Delaware River, Chester, Pennsylvania, 8.6 times 10 to the minus 6th power M; Brandywine Creek Wilmington, Delaware, 5.8 times 10 to the minus 6th power M; Delaware River, New Castle, Delaware, 2.7 times 10 to the minus 6th power M; Christiana River at Wilmington, 1.6 times 10 to the minus 7th power M; Boneyard Creek, Urbana, Illinois, 1.4 times 10 to the minus 7th power M; and Crystal Lake, Urbana, Illinois, 1.3 times 10 to the minus 7th power. Other samples of municipal water, Wastewater, and river water gave values in the range of 10 to the minus 8th power, the lowest detectable limit. (Cassar-FRC)
W82-04821

UNUSUAL POLYHALOGENATED CHEMICAL RESIDUES IDENTIFIED IN FISH TISSUE FROM THE ENVIRONMENT,
Environmental Research Lab.-Duluth, MN.
D. W. Kuehl.
Chemosphere, Vol 10, No 3, p 231-242, March, 1981. 86 Ref.

Descriptors: *Chlorinated hydrocarbons, *Fish, *Pesticides, *Pollutant identification, Bioassay, Organic compounds, Chemical wastes, Brominated compounds, Water pollution sources, Reviews.

Unusual polyhalogenated compounds identified in fish are the subject of a review of the 1970-80 literature. Not included are papers on routine monitoring or papers describing laboratory bioassays. Some of the compounds were pesticides, their metabolites, or their manufacturing intermediates: methylthiopentachlorobenzene and di-(methylthio)tetrachlorobenzene, dimethyltetrachloroterephthalate, chloronorbornadiene and chloronorborene compounds, polychlorinated dibenzo-p-dioxins, trifluralin, 1,3,5-trichloro-2-(4-nitrophenoxy)benzene, polychloro-2-(chloromethylsulfonamide) diphenyl ethers and metabolic products, pentachlorophenol, dichlorobenzophenone, hexachlorobenzene, mirex, kepone, chlordene epoxide, 1-hydrolychlordene, and toxaphene. Industrial chemicals and their intermediates are chlorofluorotoluene mixture, hexachloro-1,3-butadiene, 2,4,6-trichlorophenol, isomers of chloroguaiacol, polychlorinated dibenzofurans, polychlorinated terpehnyls, polychlorinated styrene, and 2-chloroaniline, Many brominated compounds were found in fish living in waters receiving effluents disinfected with bromine chloride. Other compounds include chloramines, trichlorophenol, pentachloroanisole, and polychlorinated napthalenes. (Cassar-FRC)
W82-04822

ANALYSIS OF MARINE SEDIMENT, WATER AND BIOTA FOR SELECTED ORGANIC POLLUTANTS,
Texas A and M Univ., College Station. Dept. of Chemistry.
H. E. Murray, L. E. Ray, and C. S. Giam.
Chemosphere, Vol 10, No 11/12, p 1327-1334, November/December, 1981. 1 Fig, 2 Tab, 30 Ref.

Descriptors: *Sediments, *Marine animals, *Aromatic compounds, *Pollutant identification, Organic compounds, Pesticides, Benzo(a)pyrene, Hexzachlorobenzene, Pentachlorophenol, Chlorinated hydrocarbons, Phenols, *San Luis Pass, *Texas, Marine sediments, Water analysis, Polycyclic aromatic hydrocarbons, Fish, Phthalates, Crabs, Squid, Shrimp.

Water, sediments, and biota collected from San Luis Pass, West Galveston Bay, Texas, in February-June 1980 were analyzed for organic pollutants. Water samples had no detectable hexachlorobenzene (HCB) or benzo(a)pyrene (BaP); pentachlorophenol (PCP) concentrations were 4.3-11 ng per liter. Average pollutantconcentrations in sediments were (ng per g dry weight); HCB, 0.49; BaP, 2.2; PCP, 0.18; dibutyl phthalate, 60; di(2-ethylhexyl) phthalate, 94; diethyl phthalate, 5; and polychlorinated biphenyls, 0.52, DDE, DDT, chlordane and dieldrin were all below the detection limits of 0103 ng per g. BaP levels in biota were all below the detection limit of 0101 ng per g wet weight. Average HCB concentrations in biota (ng per g wet weight) were: flounder, 049; longnose killifish, 0.65; brown shrimp, 0.88; blue crab, 9.6; and dwarf squid, 0.71. Average PCP levels in biota were (ng per g wet weight): flounder, 2.6; longnose killifish, 5.3; brown shrimp, 7.5; blue crab, 2.8; and dwarf squid, 1.9. The order of concentrations in biota (except blue crab) was PCP > HCB > BaP; in sedimentsat the site where the biota were collected, BaP > NCB > PCP. This indicates that the concentrations of pollutants in sediments may not accurately indicate the exposure of animals which do not ingest large quantities of sediments. (Cassar-FRC)
W82-04823

CONTENTS OF CHLORDANE-, PCB- AND DDT-COMPOUNDS AND THE BIOTRANSFORMATION CAPACITY OF FISHES IN THE LAKE AREA OF EASTERN FINLAND,
Finland Technical Research Center, Espoo.
H. Pyysalo, K. Wickstrom, R. Litmanen, P. Lindstrom-Seppa, and U. Koivusarri.
Chemosphere, Vol 10, No 8, p 865-876, August, 1981. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Fish, *Biotransformation, *Insecticides, Perch, Roach, Vendace, Trout, *Finland, Chlordane, DDT, Polychlorinated biphenyls, *Lakes, Organic compounds, Chlorinated hydrocarbons, Pesticides, *Pollutant identification, Fate of pollutants.

Chlordane compounds were detected in fish (perch, roach, vendace, and rainbow trout) in lakes of eastern Finland. Since chlordane has not been used in this region, there is a possibility that it was transported by air. Concentrations of three chlordane isomers, DDT, and polychlorinated biphenyls were reported for muscles and liver of the fish. Pollutant levels appeared to be negatively correlated with the biotransformation capacity of the fish species. Highest concentrations of pollutants were found in vendace, which had the poorest monooxygenase and conjugating activity. Rainbow trout, with the greatest biotransformation ability of the group, had the lowest pesticide levels. Perch and roach were intermediate in pesticides levels and biotransformation capacity. (Cassar-FRC)
W82-04827

ORGANOCHLORINE POLLUTANT ANALYSIS OF CONTAMINATED AND UNCONTAMINATED LAKE SEDIMENTS BY HIGH RESOLUTION GAS CHROMATOGRAPHY,
Ulm Univ. (Germany, F. R.).
H. Buchert, S. Bihler, P. Schott, H. P. Roper, and H. J. Pachur.
Chemosphere, Vol 10, No 8, p 945-956, August, 1981. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Chlorinated hydrocarbons, *Lake sediments, *Pesticides, Lakes, Sediments, *Organochlorine, *Pollutant identification, Accumulation, Polychlorinated biphenyls, Polychlorinated terphenyls, DDT, DDE, DDD, Organic compounds, Gas chromatography, Hexachlorocyclohexane.

Samples of sediments from several German lakes in industrial areas contained a variety of organochlorine pollutants, including chlorobenzenes (tri-, tetra-, penta-, and hexa-), isomers of HCH, isomers of DDT, polychlorinated biphenyls, and polychlorinated terphenyls. Maximum concentrations of several pollutants were (in micrograms per kg dry weight): HCB, 15; alpha-hexachlorocyclohexane (HCH), 316; gamma HCH, 156; 4,4'-DDE, 499; 4,4'-DDD, 747; 4,4'-DDT, 188; polychlorinated biphenyls (PCB) (60% C1), 1200; and polychlorinated terphenyls (PCT) (54% C1), 1200. Even at a depth of 6 m, traces of organochlorine compounds were detected in one lake. Surface sediments of a salt lake in Libya had traces of HCB, PCB, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT. Sediments from a rural German lake showed traces of PCB, 4,4'-DDE, and 4,4'-DDD at depth levels corresponding to the year 1920. (Cassar-FRC)
W82-04828

PERSISTENT ORGANIC CHEMICALS IN SEWAGE EFFLUENTS: I. IDENTIFICATIONS OF NONYLPHENOLS AND NONYLPHENOLETHOXYLATES BY GLASS CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
W. Giger, E. Stephanou, and C. Schaffner.

Chemosphere, Vol 10, No 11/12, p 1253-1263, November/December, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Phenols, *Surfactants, *Pollutant identification, Organic compounds, Nonylphenols, Effluents, Rivers, *Zurich, Switzerland, *Glatt River, Gas chromatography, Mass spectrometry.

Nonylphenols and nonylphenolethoxylates containing 1 to 3 oxyethylene groups were detected in effluents from activated sludge sewage treatment plants in Zurich, Switzerland. Concentrations were estimated at 100-300 micrograms per liter. In addition, several samples contained an octylphenoldiethoxylate. These compounds are persistent metabolites of nonionic detergents. Chromatograms and mass spectra of these compounds are presented. Water samples from the River Glatt, flowing through a densely populated area east of Zurich, contained nonylphenol and mono- and diethoxylated nonylphenol. (Cassar-FRC)
W82-04834

AUTOMATIC MONITORING OF COPPER IN WASTE WATER FROM PLATING SHOPS,
Siemens Naamloze Vennootschap, Oostkamp (Belgium).
J. B. Vanhumbeeck.
Water Science and Technology, Vol 13, No 11-12, p 539-544, 1981. 1 Fig.

Descriptors: *Copper, *Monitoring, *Computers, *Process control, *Colorimetry, Electroplating, Wastewater treatment, *Industrial wastes, Heavy metals, Automation, Control systems, Water analysis, Pollutant identification, Water quality control.

Wastewater from plating shops can be monitored for copper before entering the treatment regime, during the process for operation control or when leaving the plant site for emission control. A continuous monitoring process for copper levels in the discharge waters is usually required due to unreliable removal processes for this toxic heavy metal. An automatic monitoring system was developed based on the German standard colorimetric method using bathocuproin sulphonic acid. The analytical procedure was optimized, and the mechanical system was made simple, durable and easy to maintain. A simple microcomputer and data treatment system was added to control the automated monitoring process, rendering a reliable but practical copper control program for use under normal process conditions. (Geiger-FRC)
W82-04845

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITRITE IN ENVIRONMENTAL SAMPLES BY THE USE OF HYDRALAZINE,
University of Occupational and Environmental Health, Kitakyushu (Japan). School of Medicine.
H. Noda, M. Minemoto, and T. Asahara.
Journal of Chromatography, Vol 235, No 1, p 187-195, 1982. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrites, *Water analysis, Chemical analysis, Environmental protection, *Chromatography, Pollutant identification.

The usefulness of the high-pressure liquid chromatographic method is described for the determination of nitrite ion in environmental samples, particularly in biological fluids, foods and ambient waters. The procedure makes use of UV and fluorometric detectors. Hydralazine reacts with nitrite ion under acidic conditions at 37 degrees C to form tetrazolo (5,1-alpha)phthalazine (Tetra-P) almost quantitatively. The determination of Tetra-P by reversed-phase high-pressure liquid chromatography was simple, specific, sensitive and reliable over the range of 0.001-0.10 ppm of nitrite nitrogen. The hydralazine procedure is one of the most useful methods for routine analysis of nitrites in environmental samples. (Baker-FRC)
W82-04855

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS AND ASSOCIATED BENTHOS IN LAKE ERIE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie, W. Faust, W. S. Gardner, and T. Nalepa.
Chemosphere, Vol 11, No 2, p 185-191, 1982. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Lake sediments, *Aromatic compounds, *Benthic fauna, *Polyaromatic hydrocarbons, *Lake Erie, Sediments, Powerplants, Worms, Midges, Invertebrates, Aquatic fauna, Water pollution sources, Fate of pollutants, Water pollution effects.

Polyaromatic hydrocarbons (PAH) in lake surface sediments near a large coal fired powerplant on the Michigan shore of Lake Erie ranged from 0.54 to 3.75 ppm total PAH. Stations south of the plant had much lower concentrations than stations north of the plant. There was a significant correlation between percent organic matter and PAH content of the sediment. Worms and midges were scarce at the northern stations because PAH concentrations were near or above the 96 hour LC50. Oligochaete worms did not bioaccumulate PAH, but some biodegradation was noted. Midges within 1 km of the shore had the highest PAH levels. These decreased with increasing distance offshore. Midges bioaccumulated phenanthrene, fluoranthene, pyrene, chrysene, and benzo(a)pyrene. The River Raisin appeared to be a source of PAH. No point source at the powerplant was evident. Combustion products were well dispersed, and coal leachate was small in quantity. Concentrations of PAH were similar to those measured in other industrial areas. (Cassar-FRC)
W82-04882

DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FRESH WATER FISH,
Health Effects Research Lab., Research Triangle Park, NC.
R. L. Harless, E. O. Oswald, R. G. Lewis, A. E. Dupuy, Jr., and D. D. McDaniel.
Chemosphere, Vol 11, No 2, p 193-198, 1982. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Fish, *Chlorinated compounds, *Dioxins, Organic compounds, *Pollutant identification, Polychlorinated biphenyls, Tetrachlorodibenzo-p-dioxin, *Michigan.

Four to 695 ppt of 2,3,7,8-tetrachlorodibenzo-p-dioxin were found in the edible flesh of fresh water fish taken from several bodies of water in Michigan (Tittabawassee, Grand, and Saginaw Rivers, Lake Michigan, and Saginaw Bay). Twenty-six of 36 samples contained detectable quantities of this compound. Ten of the 36 samples contained levels higher than 40 ppt. Bottom feeders (catfish and carp) had higher concentrations than bass, perch, and suckers. Analysis was done by high resolution gas chromatography-high resolution mass spectrometry. Other compounds qualitatively identified in fish tissue were: chlorinated diphenyl ethers, trichlorohydroxybenzylphenyl ether, tetrachlorodibenzofurans, trichloroterphenyl, polychlorinated biphenyls, and tri- and penta-chlorodibenzo-p-dioxins. The source of this contamination was not known. (Cassar-FRC)
W82-04883

DETERMINATION OF SULFATE IN RIVER WATER BY FLOW INJECTION ANALYSIS,
Okayama Univ. (Japan). Dept. of Chemistry.
O. Kondo, H. Miyata, and K. Toei.
Analytica Chimica Acta, Vol 134, p 353-358, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Sulfates, *Water analysis, Chemical analysis, Measuring instruments, *Pollutant identification, Rivers, Water quality, Monitoring.

The determination of sulfate ion by flow injection analysis (f.i.a.) using the barium chelate of sulfonazo-III or dimethylsulfonazo-III is reported. The method can be used for 1-30 ppm sulfate ion in river water, which range covers almost all river waters in Japan. Thirty samples can be determined per hour within 1% relative error. The flow rates of the reagent solution and barium sulfate solutions are optimally 2 ml/minute each. Sample solutions are filtered through a Millipore filter and passed through an Amberlite IR120-B column before being injected. From the sample loop, 80 microliters of treated sample solution is injected into the carrier stream. Peak heights are measured at 645 nm for the sulfonazo-III method and at 662 nm for the DMSA-III method. The concentration of sulfate ion is measured from a calibration graph prepared with potassium sulfate standards. The absorption spectra of sulfonzao-III and its barium chelate show maxima at 575 nm and 643 nm, respectively. Absorbance is measured at 645 nm for greatest sensitivity. The effects of co-existing ions were investigated. Calcium ions in ordinary river water interfere with the determination. To prevent this, samples are first passed through a column of cation-exchange resin. The procedure was applied to the determination of sulfate in waters from the Asahi, the Yoshii and the Takahashi Rivers in Okayama Prefecture. Recovery tests indicate that the method was not affected by the various matters dissolved in these river waters. (Baker-FRC)
W82-04891

COMPARISON OF ATOMIC ABSORPTION SPECTROMETRIC, SPECTROPHOTOMETRIC, AND FLUORIMETRIC METHODS FOR DETERMINATION OF ALUMINUM IN WATER,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
R. Playle, J. Gleed, R. Jonasson, and J. R. Kramer.
Analytica Chimica Acta, Vol 134, p 369-373, 1982. 20 Ref.

Descriptors: *Aluminum, *Pollutant identification, Water quality, Water pollution control, Atomic absorption spectrometry, Spectrophotometry, Measuring instruments, Water analysis, Trace metals, *Comparison studies.

The ferron colorimetric method, the lumogallion fluorimetric method, and the electrothermal atomic absorption spectrometry (a.a.s.) method are compared for determining the aluminum content in water. Interferences for each method are described. It was found that in the three methods, standard additions generally gave more reliable results than calibrations against a standard curve. The ferron method gave unreliable results below about 50 micrograms/liter, while the lumogallion and a.a.s. methods yield similar results. When a large difference between these latter two methods occurred, it may have been due to the fact that a.a.s. measures total aluminum, while the lumogallion method does not measure unreactive aluminum. Natural kaolinite was selected as a representative refractory material to test the assumption that electrothermal a.a.s. quantified total aluminum in an aqueous sample. The electrothermal a.a.s. method is assumed free of interferences and has an applicable range of 10 to above 1000 micrograms aluminum/liter. The colorimetric ferron method has multiple interferences and is useful in the 50-1500 microgram aluminum/liter range. The fluorimetric method has few important interferences and is useful to below 1 microgram aluminum/liter. (Baker-FRC)
W82-04892

DETERMINATION OF TRACE METALS IN ESTUARINE SEDIMENTS BY GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY,
National Research Council of Canada, Ottawa (Ontario). Div of Chemistry.
R. E. Sturgeon, J. A. H. Desauliniers, S. S. Berman, and D. S. Russell.
Analytica Chemica Acta, Vol, 134, p 283-291, 1982. 7 Tab, 24 Ref.

Descriptors: *Sediments, *Trace metals, Estuarine environments, *Estuaries, Sedimentation, Atomic absorption spectrometry, *Pollutant identification, Copper, Cobalt, Chromium, Lead, Nickel, Berryllium.

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This report details a description of procedures which permitted the accurate determination of cadium, lead, cobalt, copper, chromium nickel and beryllium in estuarine sediments by graphite furnace atomic absorption spectrometry in combination with the L'vov Platform. The technique is interference free and permits calibration with simple aqueous solutions of metal standards. Results for lead and copper appear to be biased on the low side of acceptability. Quantitative dissolution and recovery of chromium in both sediment samples examined was evident, indicating that complete dissolution of chromium-bearing minerals was achieved and that no significant loss of volatile CrOC12 species occurred. (Baker-FRC)
W82-04893

THE USE OF XAD-RESINS FOR THE DETECTION OF MUTAGENIC ACTIVITY IN WATER. II. STUDIES WITH DRINKING WATER,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
H. J. Kool, C. F. van Kreijl, and H. J. van Kranen.
Chemosphere, Vol 10, No 1, p 99-108, January, 1981. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Ion exchange, *Mutagens, *Water analysis, Pollutant identification, Drinking water, Organic matter, *Netherlands, *Water supply, Rhine River, Meuse River.

The ion exhange method for concentrating mutagens in water, described in Part 1 of the work, was successfully applid to the anlaysis of drinking water from 6 Netherlands cities which derive their water from the Rhine and Meuse Rivers. Water from 4 of the cities showed dose-related responses. The type of mutagen mutations induced (TA98 or TA100) was different among the different cities. Water from 2 cities did not produce any mutagenic activity in the test. It is likely that the treatment processes used in these cities effectively remove organic mutagens present in the raw water supply. (Cassar-FRC)
W82-04912

USE OF XAD-RESINS FOR THE DETECTION OF MUTAGENIC ACTIVITY IN WATER. I. STUDIES WITH SURFACE WATER,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
H. J. Kool, C. F. van Kreijl, H. J. van Kranen, and E. de Greef.
Chemosphere, Vol 10, No 1, p 85-98, January, 1981. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Ion exchange, *Mutagens, *Water analysis, Rivers, Organic matter, *Pollutant identification, Surface water, *Netherlands.

An equal mixture of XAD-4 and -8 resins and dimethyl sulfoxide as an elutant were most suitable for concentration of mutagens in surface waters. Optimal flow rates were 2-4 bed volumes per minute. Most mutagenic substances were adsorbed at a neutral pH, except for a minor fraction which was adsorbed at pH 3. The mutagenic activity of the concentrate produced by XAD resin adsorption and of a concentrate prepared by freeze drying were similar. The method was tested on water from several rivers (Rhine, Meuse, and Biesbosch), wastewater plant effluent, and seawater from nearshore North Sea. (Cassar-FRC)
W82-04913

ANALYSIS OF PCBS IN SEDIMENT BY GLASS CAPILLARY GAS CHROMATOGRAPHY,
Rijksinstituut voor Visserijonderzoek,Ijmuiden (Netherlands).
M. A. T. Kerkhoff, A. de Vries, R. C. C. Wegman, and A. W. M. Hofstee.
Chemosphere, Vol 11, No 2, p 165-174, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, Sediments, *Gas chromatography, *Pollutant identification, Chlorinated hydrocarbons, Rivers, *Rhine River, Aroclors, Organic compounds, Aromatic compounds.

Sediment samples from the Rhine River and its tributaries were analyzed for polychlorinated biphenyls (PCB) by glass capillary gas chromatography. Sediment samples from 6 rivers contained from 1.0 to 3.9 mg per kg total PCB as determined by the capillary method. The perchlorination method, which converts all PCB's to the decachlorobiphenyl, produced results 1.1 to 3.7 times higher than those obtained by the capillary gas chromatograph. Mean recovery of 13 individual components of Aroclor 1242 was over 85% in spiked samples. Seventeen individual components were identified. The glass capillary gas chromatographic method, which provides information on individual PCB components, may be useful in identifying sources of contamination. (Cassar-FRC)
W82-04916

COPROSTANOL AND BACTERIAL INDICATORS OF FAECAL POLLUTION IN THE SCHELDT ESTUARY,
Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium).
M. Yde, E. De Wulf, S. De Maeyer-Cleempoel, and D. Quaghebeur.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 2, p 129-134, February, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Coprostanol, *Indicators, *Bacteria, Pollutant identification, Bioindicators, *Coliforms, *Scheldt Estuary, Streptococcus, Clostridium, Sewage bacteria, Feces, Netherlands, Belgium.

Coprostanol (5-beta-cholestan-3-beta-ol), a steroid present in animal and human feces, was tested as an indicator of fecal pollution in waters of the Scheldt estuary (The Netherlands-Belgium). Analysis was performed by conversion to the trimethylsilyl derivative, followed by gas chromatography using a flame ionization detector and glass capillary column. For comparison, total coliforms, fecal coliforms, fecal streptococci, and sulfite-reducing clostridia were determined. Coprostanol levels were not as reliable as the bacterial indicators in determining fecal pollution. In some samples bacteria were detected but coprostanol was below the detection limit. However, coprostanol analysis may be useful in determining fecal pollution in waters where bacteria have been destroyed by thermal pollution or toxic substances, by low temperatures, or by a delay between sampling and analysis. (Cassar-FRC)
W82-04923

AUTOMATED TURBIDIMETRIC DETERMINATION OF SULPHATE IN SURFACE, GROUND AND DOMESTIC WATER BY FLOW-INJECTION ANALYSIS,
Pretoria Univ., (South Africa). Dept. of Chemistry.
J. F. Van Staden.
Fresenius Zeitschrift fur Analytische Chemie, Vol 310, No 3/4, p 239-242, 1982. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Sulfates, Chemical analyis, *Pollutant identification, Flow injection analysis, *Turbidity, Surface waters, Groundwater, Drinking water.

A flow-injection procedure is reported in which one sampling loop of a two-position sampling valve is used to sample an alkaline buffer-EDTA solution alternating with water samples picked up on the other loop, obviating acidification of water samples and reducing baseline drift. The procedure as described is suitable for carrying out sulfate analysis at a rate of about 60 water samples per hour. The alkaline buffer-EDTA solution dissolves any residual precipitate coating the walls of the flow cell and keeps the system clean. The coefficient of variation is better than 0.95%. The reproducibility of the method was tested on standard sulfate solutions and water samples. (Baker-FRC)
W82-04935

DATA ACQUISITION AND EVALUATION IN BIOLOGICAL MONITORING SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
D. Gruber, and J. Cairns.
Hydrobiologia, Vol 83, No 3, p 387-393, 1981. 2 Fig, 25 Ref.

Descriptors: *Water quality, *Monitoring, *Bioindicators, Pollutant identification, Indicators, Behavior, Respiration, Water pollution control, Wastewater, Computers, Automation, *Fish, Data acquisition, Data interpretation.

The ventilatory rates of fish may be used in biological monitoring for continuous and automated pollutant detection. Over the past 15 years many studies have used the ventilatory behavior of fish to assess wastewater quality. A variety of ventilatory parameters have been measured, including ventilatory frequency, ventilatory amplitude, and gill purges or coughs. Methods developed for receiving the ventilatory signals have incorporated manometric techniques, attached electrodes, unattached electrodes, and visual observation. The most suitable method for industrial use incorporated noncontact submerged electrodes. Strip chart recorders have typically been utilized for fish ventilatory signal acquisition, as they are relatively inexpensive, are easily interfaced to electrodes, and provide a hard copy of the data. Some systems allow the ventilatory rates of 12 fish to be accumulated continuously with the aid of an online minicomputer. It is important that differences among fish be considered when analyzing ventilatory behavior. The static baseline approach to data handling is discussed, along with a time series approximation. Widespread application of on-line biomonitoring systems will almost certainly require computer technology. The incorporation of computer based biomonitoring apparatus facilitates collections of data from many fish almost continuously. The computer can be programmed to trigger a water sampler whenever the fish are behaving abnormally. (Baker-FRC)
W82-04944

THE USE OF THE THREE-RIDGE CLAM (AMBLEMA PERPLICATA) TO MONITOR TRACE METAL CONTAMINATION,
Purdue Univ., Lafayette, IN. School of Pharmacy and Pharmacal Sciences.
T. G. Adams, G. J. Atchison, and R. J. Vetter.
Hydrobiologia, Vol 83, No 1, p 67-72, 1981. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Bioindicators, *Rivers, Industrial wastes, Indicators, Pollutant identification, Clams, Water pollution, *Zinc, *Cadmium, *Electroplating, *India.

The use of the three-ridge clam as a monitor of zinc and cadmium contamination in two freshwater streams was evaluated. The streams, Williamson Ditch and Trimble Creek, are located in northcentral India. An electroplating plant discharges wastes that contain zinc and cadmium into Williamson Ditch about 3 km from Palestine Lake. Clams were collected from a relatively uncontaminated area in one river and transported to four study sites in the two contaminated streams. The clams were placed into polyethylene cages and left in these streams for one week. Control clams were treated in a similar manner and left in the uncontaminated river. The highest mean concentration of zinc was 956 micrograms/gram dry weight and was found in the gill tissue of clams from the most contaminated site. The highest mean cadmium concentration, 18.6 micrograms/gram dry weight, was found in the digestive glands, also from the most contaminated site. Mean concentrations at contaminated sites were signigicantly higher than background and control levels. These findings suggest that these particular organs of clams may be useful in monitoring levels of zinc and cadmium in other freshwater systems. (Baker-FRC)
W82-04948

THE EFFECTS OF DISSOLVED HEAVY METALS ON ATTACHED DIATOMS IN THE UINTAH BASIN OF UTAH, U.S.A.,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
S. R. Rushforth, J. D. Brotherson, N. Fungladda, and W. E. Evenson.
Hydrobiologia, Vol 83, No 2 p 313-323, 1981. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Heavy metals, *Diatoms, Basins, *Utah, Streams, River basins, Chemical properties, Water analysis, Bioindicators, *Ecological effects.

A study was performed to examine how diatoms differ in their response to heavy metal concentrations in natural systems. Initial data was also collected on the response to heavy metals of important diatom species in order to suggest further autecological studies. Samples of diatom populations were collected from 22 sites along selected streams in the Uintah Basin of Utah during 1977-1978. Seasonal changes in the concentrations of heavy metals were noted. The trends noted were largely due to runoff patterns and characteristics of the river drainage basins. The study demonstrated that under field conditions several diatom species showed different patterns of abundance with varying concentrations of heavy metals. Such responses were shown to be probably related to seasonal differences. This is due to the fact that environmental factors do not operate separately from one another, but rather in some sort of interaction, be it complememtary or antagonistic. Thus the effects of heavy metals on diatom species would be expected to be mitigated by other environmental parameters, such as day length, temperature, nutrients of water hardness. Achnanthes minutissima, Cylotella meneghiniana, Cymbella minuta, Gomphonema parvulum, Navicula secreta var. apiculata, Nitzschia frustulum, Nitzschia frustulum var. perminuta, Nitzschia pale, and Synedra ulna appear to be indicator species of high or low heavy metal concentrations. Other species also demonstrated meaningful relationships to high or low heavy metal concentrations. (Baker-FRC)
W82-04951

PRELIMINARY SCREENING OF BACTERIAL COMPONENTS AS ORGANIC PRECURSORS TO THE FORMATION OF TRIHALOMETHANES,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 5F.
W82-04957

INFLUENCE OF CHLORINATION AND THE DISTRIBUTION SYSTEM ON MUTAGENS IN A POTABLE WATER SUPPLY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. B. Johnston, and R. R. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220674, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 168, March 1982, 137 p, 33 Tab, 26 Fig, 53 Ref, 2 Append. OWRT B-125-ILL(1). USDI 14-01-0001-9148.

Descriptors: Ames assay, *Chlorination, Distribution system, *Mutagens, Polynuclear aromatic hydrocarbons, *Potable water, *Water supply systems.

A growing number of studies have detected mutagens in public water supplies. This study examined a central Illinois public water supply and found the presence of mutagens dependent on mammalian metabolism (promutagens) in addition to chlorination-related, direct-acting mutagens. Both kinds of mutagens were recovered by adsorption on polyurethane foam and quantitated by the Ames Salmonella/microsome reversion assay. It was found that the pro-mutagens first appeared in the distribution system (following treatment) and that the direct-acting activity increased somewhat within the system. It was found that chloramine disinfection produced water with more protomutagenic activity than direct-acting mutagenicity and that chlorination beyond break-point reversed this order. Detailed study of the time of appearance of mutagens and chlorine residuals showed patterns consistent with the formation of direct-acting mutagens by reaction of the free chlorine residual with substances in the water - possibly materials contributed by the distribution system. Particulate matter collected from hydrant flush water at dead ends in the distribution system were found to harbor high amounts of two known carcinogens and other unidentified mutagenic substances. These high levels of mutagens were not found in tap water, nor could the carcinogens be identified in the tap water.
W82-04961

QUANTIFICATION OF OCTACHLOROSTYRENE AND RELATED COMPOUNDS IN GREAT LAKES FISH BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Environmental Research Lab.-Duluth, MN.
D. W. Kuehl, K. L. Johnson, B. C. Butterworth, E. N. Leonard, and G. D. Veith.
Journal of Great Lakes Research, Vol 7, No 3, p 330-335, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Fish, *Chemical analysis, *Chlorinated compounds, *Great Lakes, Gas chromatography, Mass spectrometry, Octachlorostyrene, *Pollutant identification.

Studies have been underway since 1974 on gas chromatographic-mass spectrometric (GC-MS) exploration of organic chemical residues in composite samples of fishes from major watersheds in the United States. A large bank of fish tissue samples was established. These samples were utilized to estimate the levels of octachlorostyrene and related polychlorinated hydrocarbons in Great Lakes fish. Whole fish were composited, ground, dried with anhydrous sodium sulfate, and extracted with hexane. The extract was concentrated, cleaned up on a Florisil column, and analyzed by multiple ion detection of two ions for each compound on a computerized system with peak-finding and quantification software. The results indicate that octachlorostyrene residues in fish from the two uppoer lakes, Superior and Michigan, were below the detection limit of 5 ng/g (wet weight), while residues in fish from Lakes Huron, Ontario and Erie reached as high as 400 ng/g. Fish from the Ashtabula River/Field Brook area contained extremely large quantities of octachlorostyrene and other chlorinated compounds, suggesting specific industries as the source of these pollutants. (Carroll-FRC)
W82-04993

ON THE USE OF FILTERS FOR DISTINGUISHING BETWEEN DISSOLVED AND PARTICULATE FRACTIONS IN NATURAL WATERS,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
L. G. Danielsson.
Water Research, Vol 16, No 2, p 179-182, February, 1982. 2 Fig, 16 Ref.

Descriptors: *Filtration, *Natural waters, Water, Colloids, Water quality, Iron, Heavy metals, Pore size, Particulate matter, Lakes, Bogs, Estuaries, Marshes, Swamps, *Lake Alenashalan, Sweden.

The effects of filtration on colloidal matter present in natural waters were investigated. Samples were taken from Lake Alenashalan in southwestern Sweden. The lake is surrounded by peat bogs and is high in concentration of iron and humic substances. Even though these substances are present in high concentrations here, the compounds responsible for them are present in most natural waters. The nature of these compounds is probably a co-colloid of iron hydroxide and organic compounds. The two types of membrane filters used in the study have widely different construction. Millipore filters are made of a copolymer of cellulose nitrate and cellulose acetate, forming a three dimensional net. The specified pore size is actually a mean value. Nucleopore filters have a somewhat better defined pore size, as these filters are made by perforating a sheet of polycarbonate in a well defined way. The filtration characteristics are, however, rather similar for the two filters. The use of filters of normal pore sized (0.4 to 0.7 micrometers) is inadequate for the separation of particulate and truly dissolved fractions of metals in natural waters, especially for colloid-laden samples such as bog waters, woodland streams and lakes, and estuarine waters. Use of membrane filters for the removal of large particles from a water sample can introduce large errors due to the changing effective pore size caused by clogging. For large volume filtrations, frequent filter change and/or large area filters should be used. Filter holders supplied with stirrers like those used for ultrafiltration might also be beneficial in helping to avoid clogging. (Baker-FRC)
W82-05012

BIOLOGICAL MONITORING, PART IIA - RECEIVING SYSTEM FUNCTIONAL METHODS, RELATIONSHIPS AND INDICES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. A. Matthews, A. L. Buikema, Jr., J. Cairns,Jr., and J. H. Rodgers, Jr.
Water Research, Vol 16, No 2, p 129-139, February, 1982. 1 Tab, 113 Ref.

Descriptors: *Monitoring, *Reviews, Ecosystems, Stres, Water quality, Water resources development, Stress analysis, *Biological properties, *Environmental effects.

Biological monitoring is defined as the systematic use of biological responses to evaluate changes in the environment with the intent to use this information in a quality control program. Biological monitoring is reviewed primarily from the functional aspect, integrating structure and function into a more complete picture of exosystem response to stress. Ecosystem structure considers the composition of the biological community, including species, numbers, biomass, life history and spatial distribution of populations, the quantity and distribution of the abiotic materials, and the range or conditions of existence. Function is concerned with the rate of biological energy flow through the ecosystem, the rate of material or nutrient cycling, biological or ecological regulation, and regulation of the environment by the organisms. Functional responses to stress in aquatic systems can be studied by photosynthesis and respiration measurements taken at the population level or higher. Physicochemical measurements, behavioral changes, and changes in physiological functions such as nitrogen fixation and electron transport can also be used as measurements. Effective biomonitoring should emphasize a combined structure/function testing strategy. A holistic evaluation should include the measurements of both biotic and abiotic structural and functional parameters, should include community and higher level biomonitoring tests in testing strategies, and should include comparison studies between microcosms and field systems. A high correlation between microcosm and field responses would allow effluent hazard evaluations to be made with the least amount of risk. (Baker-FRC)
W82-05013

VIRAL POLLUTION DETERMINATION OF SUPERFICIAL WATERS (RIVER WATER AND SEA-WATER) FROM THE URBAN AREA OF BARCELONA (SPAIN),
Barcelona Univ. (Spain). Dept. de Microbiologia.
F. Lucena, C. Finance, J. Jofre, J. Sancho, and L. Schwartzbrod.
Water Research, Vol 16, No 2, p 173-177, February, 1982. 3 Tab, 21 Ref.

Descriptors: *Water quality, *Measuring instruments, Rivers, Marine environment, Bacteria, *Viruses, Public health, Human diseases, *Spain, Municipal wastes, *Surface water.

A survey of virus occurrence was performed using the method of adsorption onto glass powder for concentrating the virus in a variety of aquatic systems located in the metropolitan area of Barcelona, Spain, including two rivers and three beaches. Samples were always collected from a depth of 30 cm. Viruses were recovered from all samples. Values were high and ranged from 18.4 to 55 most probable number of cytopathogenic units (MPNCU)/liter in the samples corresponding to the Besos River and from 0.44 to 44 MPNCU/liter from the Llobregat River. Levels of viruses in the Besos were about 10 times higher than the values from the Llobregat River. corresponding to other parameters of pollution. Viruses were also recovered in all samples from the three marine locations

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near the beaches. The viruses spread far from the shore, since the number of viruses recovered from samples taken 2, 5, 20, and 1,000 meters from the outfall did not differ significantly. The percentage of positive assays decreased in June. These findings confirm that current methods for determining the microbial quality of coastal sea-waters used for recreational purposes such as bathing and sailing are inapplicable to viruses. The findings also indicate that the survival time of viruses in sea water is longer than the survival time of bacteria. (Baker-FRC)
W82-05014

GC/MS ANALYSIS OF XAD-2 EXTRACTS OF SUPERCHLORINATED SEPTAGE,
North Texas State Univ., Denton. Dept. of Chemistry.
J. E. Henderson, and W. H. Glaze.
Water Research, Vol 16, No 2, p 211-218, February, 1982. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Chlorination,*Wastewater treatment, Municipal wastewater, Public health, Chlorinated hydrocarbons, *Organic compounds, *Mass spectrometry.

A new mass spectral search system is presented for the detection of chlorinated and brominated organic compounds formed by the superchlorination of a septage. Samples of raw and superchlorinated septage were used. Many of the halocarbons found in this study are structurally similar and in may cases identical to compounds formed from the chlorination of humic material and surface water organics. Compounds detected through a purge and trap analysis included methylene chloride, acetone, diethylether, acetic acid, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, alpha,alpha,beta-trichloropropionitrile, toluene, chlorobenzene, chlorotoluene, and dichlorobenzene. Compounds determined through microcoulometric analysis of XAD-resin/ether extracts included chloroform, dichlorobenzene, tetrachloroacetone, dichlorobenzene, chlorobutendione-3, dichlorotoluene, and trichlorotoluene. It is suggested that neutral chloro-aromatics result from the decarboxylation of the corresponding aromatic acids that are formed during oxidative cleavage of the humic polymer. Whether chlorination occurs before or after oxidative cleavage of the polymer or both is not clear. Nor is it clear that a radical chlorine intermediate is responsible for the decarboxylation process. It is concluded that the major chlorinated compounds from the chlorination of municipal wastewaters appear to result from chlorination and degradation of humic substances present in the water and bear striking resemblance to products obtained from natural humics and model compounds thought to be constituents of humic and fulvic acid. (Baker-FRC)
W82-05016

MEASUREMENT OF EFFECTS OF CARBARYL IN SURFACE WATER ON FECAL POLLUTION INDICATOR BACTERIA BY USE OF PLATE COUNTS AND RESPIROMETRY,
Texas Univ., Houston. School of Public Health.
U. A. Anugwelem, and R. K. Guthrie.
Water Research, Vol 16, No 2, p 219-221, February, 1982, 2 Fig, 16 Ref.

Descriptors: *Water quality, *Monitoring, Public health, *Carbaryl, Pesticides, Insecticides, Bioindicators, Indicators, *Escherichia coli, Streptococcus faecalis, *Bacteria.

The objectives of the present study were to determine the responses of Escherichia coli and Streptococcus faecalis to the presence of low concentrations of carbaryl, as measured by plate counts; to assess changes in numbers of viable organisms; and by Warburg respirometry, to assess changes in metabolic rates. The results of the study indicate that the presence of carbaryl in surface water would cause a more rapid die-off of these indicator organisms, with S. faecalis dying off more rapidly than E. coli. If this occurred in a polluted water source it could result in false or misleading conclusions, as Geldreich has suggested that the presence of certain fecal streptococci indicates recent fecal pollution of water and other investigators have reported that these organisms survive longer in water than do coliforms. To provide a different measure of the effects of carbaryl on these fecal pollution indicators, oxygen uptake as measured by Warburg respirometry was determined. Oxygen uptake by pure cultures of E. coli in the presence of 1 mg/liter carbaryl was significantly increased as compared to uptake by E. coli controls. Oxygen consumption by pure cultures of S. faecalis was decreased significantly in the presence of both 1 and 5 mg/liter carbaryl. The data indicate the desirability of using more than one method when seeking to determine the effect of chemicals on microorganisms, as the fecal results obtained by the two methods here appeared to be contradictory until the early data from plate counts were considered and the different results in early and late time frames were noted. (Baker FRC)
W82-05019

A SIMPLE AND RAPID METHOD FOR THE DETERMINATION OF LEAD AND CADMIUM IN SEDIMENT BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
M. Sakata, and O. Shimoda.
Water Research, Vol 16, No 2, p 231-235, February, 1982. 1 Fig, 6 Tab, 10 Ref.

Descriptors: *Sediments, *Pollutant identification, *Cadmium, *Lead, Spectroscopy, *Atomic absorption spectroscopy, Chemical analysis, Sedimentation.

A simple and rapid method is presented for the routine determination of lead and cadmium in sediment using graphite furnace atomic absorption spectrometry. Sample solutions are injected into the graphite furnace by means of an automatic sampling device for the rapid and simple analyses. The automated analysis procedure has better precision than the manually per formed method. Dry sediment is digested for 1 hr at 140 C with a mixture of hydrogen fluoride, nitric acid, and hydrochloric acid in the Teflon-lined bomb. Severe interference was offered by several major elements, including sodium and potassium. However, such disturbances can be overcome by adding to the sample a 1% solution of ammonium phosphate in the same volume as the sample solution for lead and 1% ammonium sulfate for cadmium as matrix modifiers. In thirty-six sediments taken from 13 reservoirs in remoter areas of Japan, the average contents of lead and cadmium were 35 and 0.40 ppm for cadmium on the basis of dry sediment. The proposed method is applicable to the routine determination of a large number of sediments with minimal effort. (Baker-FRC)
W82-05020

BIOLOGICAL MONITORING, PART III.- RECEIVING SYSTEM METHODOLOGY BASED ON COMMUNITY STRUCTURE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, and J. Cairns, Jr.
Water Research, Vol 16, No 2, p 141-153, 1982. 2 Fig, 1 Tab, 104 Ref.

Descriptors: *Monitoring, *Reviews, Water quality, *Ecosystems, Aquatic life, Aquatic habitats, Data collections, Data acquisition, Aquatic life, Biological samples, *Pollutant identification.

The use and limitations of data that describe the structure of aquatic communities are discussed, first in terms of data resources and the range of analysis techniques available, then in terms of interpretative methodologies for input to management and protection decisions, including limits that should be placed on data. The analysis of aquatic ecosystem structure requires identification and enumeration of community elements. Procedures which facilitate extraction off information follow classical investigative approaches that require formulation of a hypothesis followed by data collection and analysis to support or nullify the hypothesis. The procedures that employ structural analysis methodologies are based on the theory of species abundance relationships as well as community identification based on indicator, target, or keystone species. Monitoring programs can be categorized as descriptive or analytical. Descriptive approaches include biomonitoring designs which establish baselines, identify trends, and only allow inference of cause-effect relationships. Both descriptive and analytical biomonitoring are dependent on data analysis procedures. Specific sample analysis procedures are dependent on the quality and thoroughness of both the collection procedures and processing and identification of samples . Multiply sample analysis allows comparisons to be made between samples. The capacity to discriminate between samples and the importance of identifying why sample differences occur is the goal of aquatic community biomonitoring. The goal of biomonitoring efforts should be the development of information resources that will allow decision making based on certainty of cause-effect relationships. This can be achieved through a conjunction of descriptive and analytical approaches to community structure biomonitoring. (Baker-FRC)
W82-05023

DETERMINATION OF CADMIUM IN LAKE MICHIGAN BY MASS SPECTROMETRIC ISOTOPE DILUTION ANALYSIS OR ATOMIC ABSORPTION SPECTROMETRY FOLLOWING ELECTRODEPOSITION,
Argonne National Lab., IL.
J. Muhlbaler, C. Stevens, D. Graczyk, and T. Tisue.
Analytical Chemistry, Vol 54, No 3, p 496-499, March, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Cadmium, *Water analysis, Lakes, *Lake Michigan, Chemical analysis, *Mass spectrometry, Atomic absorption spectrometry, Electrodeposition, Mass spectrometric isotope dilution.

Mass spectrometric isotope dilution analysis was used to assess the efficiency of the electrodeposition and stripping procedure described and to study control of contamination in sampling and handling operations in attempts to determine cadmium concentration levels in Lake Michigan. One of the goals of the study was therefore to evaluate the suitability of electrodeposition for routine use as a means of preconcentrating cadmium prior to atomic absorption analysis. When specific precautions were taken, the electrodeposition-MSID combination proved suitable, yielding a concentrate that is free of significant interferences and giving steady ion currents from samples and blanks containing 25-100 ng total cadmium. In practice, the lower working limit was determined by the blank value rather than by the inherent sensitivity. It is the variability introduced by contamination that appears to control the overall precision. The most persistent and troublesome source of this contamination was cadmium-laden particulate matter in the laboratory and shipboard atmospheres. Use of closed containers and clean air work stations was effective in dealing with these problems. When using MSID, the calculated instrumental limit of detection was less than 0.1 ng, well below the limits imposed by the observed precision and blank values. The overall procedure had a precision of 14% relative standard deviation. Electrothermal atomic absorption spectrometric detection gave a relative precision of 19%. The main cadmium concentration in Lake Michigan water samples collected in 1978 ranged from 31 to 41 ng/liter. (Baker-FRC)
W82-05040

EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF CADMIUM BASED ON THE FORMATION OF A TERNARY COMPLEX WITH CADION AND 1,10-PHENANTHROLINE,
China Univ. of Science and Technology, Hefei. Dept. of Chemistry.
S. Nai-kui, W. Fu-sheng, and Q. Qi-ping.
Analytical Letters, Vol 14, No 19, p 1565-1577, 1981. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Cadmium, *Spectrophotometry, Chemical analysis, Measuring instruments, Pollutant identification, *Industrial wastewater, Electroplating.

A method is reported for the determination of cadmium in electroplating wastewater. An aliquot of the cadmium sample (less than 5 micrograms of cadmium) was pipetted into a 60-ml separating funnel, adding 2 ml of 0.2% 1, 10-phenanthroline, and 7 ml of 2N sodium hydroxide, and diluted nearly to 28 ml with distilled water to give approximately a 0.5 N basicity in sodium hydroxide. Then add 0.5 ml of 0.025% ethanolic solution of Cadion and exactly 5 ml of chloroform and shake vigorously for 2 minutes. Allow the phases to separate and then drain off the chloroform layer into a dry small test tube, and measure the absorbance in a 1-cm cell at 490 nm against reagent blank. (Baker-FRC)
W82-05041

PROBLEMS OF THE DETECTION OF ORGANIC TRACE SUBSTANCES IN WATER (ZU PROBLEMEN DES NACHWEISES ORGANISCHER SPURENSTOFFE IM WASSER),
R. Koch.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 3-17, 1980. 1 Fig, 6 Tab, 73 Ref. (No English Summary).

Descriptors: *Chemical analysis, *Water quality, *Organic compounds, Gas chromatography, Thin layer chromatography, Sample preparation, Data acquistion, Experimental design, Screening, *Toxins, Trace levels.

The possible methods for detection of individual toxicologically relevant water contaminants are reviewed. Prerequisites for performance of analytical screening are outlined. Methods of test substance enrichment, separation of mixtures, and detection and identification of individual compounds are discussed, along with questions of the systematization and standardization of test methods and data acquisition. The importance of the sampling procedure employed should not be underestimated. The principal enrichment techniques performed today are adsorption and liquid/liquid extraction. Gas chromatography (GLC) and thin-layer chromatography (TIC) are the most common methods for separation and identification of individual substances. Results obtained by TLC are often confirmed by IR, UV or fluorescence spectrometry, and GLC results by mass spectrometry. A great variety of solvent systems are available for TLC separation of various groups of substances, and group regents serve for detection of specific substance groups. Screening of water samples for unknown contaminants, followed by specific confirmatory techniques, is now possible. Analysis of all compounds present is not necessary for water quality or public health purposes; a selection must be made based on the toxicologic significance, ecological fate, productin quantities, and application areas of the compounds. (Carroll-FRC)
W82-05093

DETERMINATION OF ARSENIC AND ANTIMONY IN WATER AND SOIL BY HYDRIDE GENERATION AND ATOMIC ABSORPTION SPECTROSCOPY,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
J. A. Haring, W. Van Delft, and C. M. Bom.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 310, No 3/4, p 217-223, 1982. 6 Fig, 6 Tab, 9 Ref.

Descriptors: *Metals, *Water analysis, Atomic absorption spectroscopy, *Arsenic, *Antimony, Water quality, Soils, *Pollutant identification, Colorimetry.

This report describes the optimization of analytical parameters such as temperature of the quartz cell, pH of the sample and the effect of the valence of the elements in the sample on the rate of metal-hydride formation, as related to the determination of arsenic and antimony in water and soil. Descriptions are also offered of the graphite furnace technique and a colorimetric method. During the intercomparison experiments, the importance of adding potassium iodide before the addition of sodium borohydride reagent to the sample was clearly demonstrated. Compared with the colorimetric technique, the atomic absorption hydride technique with the heated quartz cell was found to suffer from interferences by other hydride forming elements. Slow addition of NaBH4 (over 5 minutes in case of the colorimetric method) resulted in a longer reaction time, giving a complete transformation of the hydride forming elements. The optimization of various analytical parameters with respect to the hydride technique is discussed. (Baker-FRC)
W82-05141

FINGERPRINTING INORGANIC ARSENIC AND ORGANOARSENIC COMPOUNDS IN THE SITU OIL SHALE RETORT AND PROCESS WATERS USING A LIQUID CHROMATOGRAPH COUPLED WITH AN ATOMIC ABSORPTION SPECTROMETER AS A DETECTOR,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. H. Fish, F. E. Brinckman, and K. L. Jewett.
Environmental Science and Technology, Vol 16, No 3, p 174-179, March, 1982. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Oil shale, *Arsenic, *Industrial wastes, Chemical analysis, Public health, Environmental effects, Hazardous wastes, Toxicity, Path of pollutants, *Toxins, *Pollutant identification.

Inorganic arsenic and organoarsenic compounds were speciated in seven oil shale retort and process waters, including samples from simulated, true, and modified in situ processes, by using a high performance liquid chromatograph automatically coupled to a graphite furnace atomic absorption detector. Molecular forms of arsenic were identified in these waters for the first time at ppm levels and shown to include arsenate, methylarsonic acid, and phenylarsonic acid. The significant environmental finding is that these potentially toxic inorganic arsenic and organo-arsenic compounds in varied mixtures at appreciable concentrations are either released or synthesized during oil shale retorting processes representing present day technology. The possibility of their bioaccumulation in soils, water and edible biota at appreciable distances from the retorting site via disposal of retort leachate waters containing bioactive forms may represent potential health hazards for humans as well as a threat to aquatic species. (Baker-FRC)
W82-05151

BIOLOGICAL MONITORING OF HAZARDOUS WASTES IN AQUATIC SYSTEMS,
Environmental Monitoring Systems Lab. Las Vegas, NV.
V. W. Lambou, and L. R. Williams.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 11-18.

Descriptors: *Bioassay, *Monitoring, *Aquatic environment, Aquatic life, Water pollution, Pollutants, Environmental effects, Bioaccumulation, *Hazardous materials, Population density, Species composition, Wastes, Biological samples.

Biological monitoring has had a relatively weak supportive role in monitoring programs of the past; however, it is rapidly attaining the recognition it warrants in a systems approach to monitoring. Physical and chemical testing cannot predict the cumulative impacts and/or the interactions of mixed pollution sources on environmental health. Biological monitoring is well-suited for this as the biota in aquatic systems responds to the sum of the interactions of environmental factors and integrates their effects over time. Approaches to biomonitoring include in-situ bioassays, bioaccumulation, use of indicator organisms, community and population changes, and species health. For selection of appropriate biomonitoring techniques, the monitoring requirements of a specific program should be clearly determined; the selection criteria provided should be reviewed and prioritized relative to those monitoring requirements identified; and the selection criteria should be rigorously applied in determining those tests or measurements needed to meet program objectives. Biological monitoring methods which are sensitive, simple to apply, reproducible, and economical in their application, and which provide answers to vital environmental questions in realistic time frames, are already in use and will have increasing application in the future. (Brambley-SRC)
W82-05154

ENZYMES AND OTHER BIOCHEMICAL INDICATORS OF TOXICANT EFFECTS IN FISHES,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 5C.
W82-05155

OVERVIEW AND ASSESSMENT OF BIOLOGICAL SENSING,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5C.
W82-05156

NEW IN-SITU TECHNIQUES IN BIOMONITORING,
BioControl Co., Inc., Port Sanilac, MI.
H. E. Schlichting, Jr.
In: 2nd Interagency Workshop on In-Situ Water Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 55-58, 1 Tab, 7 Ref.

Descriptors: *Biomonitoring, *Bioindicators, *Water quality, *Aquatic life, Chemical properties, Physical properties, Water pollution, Algal growth, Biomass, Species diversity, Morphology, Prediction.

Continuous in-situ biological monitoring systems continually assess the responses of selected indicator organisms to the changes occurring in the water chemistry and physical parameters. Successful prediction of water quality changes depends upon the selection of indicator organisms, membrane filter selectivity, and the measurement of pertinent physical and chemical data at the test sites. Measurements of biomass increase, organism health, species diversity, and morphological and physiological changes can be used to estimate the degree of eutrophication or the presence of toxic pollutants. Algal growth potential when determined for a period of a year, can be used in predicting future water quality changes. The importance of recording the physical and chemical parameters, including light, is noted. Biomonitors can be used in other studies including measurement of radionuclide bioconcentration, degree of toxicity of sewage effluent, heavy metals, pesticides, growth regulators and fertilizers in selected organisms in strip mine ponds, lakes, and rivers. (Brambley-SRC)
W82-05157

COMPUTER INTERFACED SYSTEMS FOR BIOLOGICAL MONITORING OF WATER QUALITY,
Virginia Polytecnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 81-101, 15 Fig, 19 Ref.

Descriptors: *Monitoring, *Bioindicators, *Automation, *Water analysis, *Water pollution, Computers, Chemical properties, Physical properties, Fish behavior, Water quality control, Effluents, Cost analysis, Aquatic life.

It is necessary to couple biological with chemical and physical data for effective environmental protection and quality control. Continuous biological monitoring is not routine because of the cost and time required for examination of the biological material. Progress in automation of biological mon-

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itoring has led to an early warning system, automated identification, automation of behavior analysis, and simulation of variable effluent discharges. The automated early warning system monitors fish movement and breathing during continual exposure to a diluted waste stream. A distress response is used to trigger an alert so that remedial action can be taken. The automated identification unit is a pattern recognition system using species such as diatoms. Sample counts are made, and on the basis of species diversity and numbers an evaluation of pollution level may be made. Automated behavior analysis has been used to obtain preliminary estimates of preference, avoidance, and induction of aberrant behavior in fish exposed to pollutants. A unit has been designed to monitor fish ventilation in response to variable effluent discharges such as are likely to occur in streams. More work is required before it can be used as a routine monitor. Automated monitoring can be cost effective and provides improved data analysis, storage and retrieval capabilities. (Brambley-SRC)
W82-05158

METABOLIC RESPONSE OF FISH TO STRESS,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
For primary bibliographic entry see Field 5C.
W82-05159

ENZYMES AND ANTIBODIES AS SENSORS OF TOXIC SUBSTANCES,
Midwest Research Inst., Kansas City, MO.
D. R. Sellers.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 143-160, 6 Fig, 2 Tab.

Descriptors: *Enzymes, *Water pollution, *Pesticides, *Biodetection, *Antibodies, Electronic equipment, Monitoring, Bioindicators, Air pollution, Effluents, Industrial wastewater, Soil contamination, Phenols, Metals, Phthalates, *Toxins.

Biodetection is the name given to the use of a combination of electronics and material from living tissue for the estimation of compounds in nature. The biological part, either an enzyme or an antibody, provides rapid sensitivity and specificity while the electronics portion magnifies the signal into readout formats. Most work has been done using cholinesterase, in part because it is sensitive to organophosphate and carbamate pesticides. The enzyme can be immobilized for detection of pesticides in water or impregnated in a base for detecting pesticide vapors. Both applications are in commercial use, monitoring wastewater effluent from a pesticide plant, and monitoring the air within the plant, respectively. A soil analysis technique has also been developed. Fifty-two enzymes have been identified which are inhibited by one or more compound on the EPA's priority pollutant list in the groups pesticides, phenols, metals, and phthalates, so that there are good prospects of incorporating them in biodetection equipment for continuous monitoring. An antibody-based biodetection system has been developed to detect 2,4-dinitrophenol. It uses a coupled enzyme system to amplify the signal and provide a display related to the amount of antigen present. (Brambley-SRC)
W82-05160

BIOPROBES FOR THE MONITORING OF TOXIC COMPOUNDS AND HAZARDOUS MATERIALS IN WATER,
New Orleans Univ., LA. Dept. of Chemistry.
S. S. Kuan, and G. G. Guilbault.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 161-165, 12 Ref.

Descriptors: *Monitoring, *Bioindicators, *Enzymes, *Water pollution, *Hazardous materials, Electronic equipment, Nitrate, Nitrite, Cyanide, Carbamate pesticides, Electrodes, Decontamination.

Bioprobes and analytical systems for fast, simple accurate, selective, and sensitive assay have been developed for a number of compounds, including the water pollutants nitrate and nitrite, cyanide, and carbamate pesticides. The nitrate/nitrite bioprobe depends on the successive reduction of nitrate to nitrite by nitrate reductase, and nitrite to ammonia by nitrite reductase, and the measurement of ammonia by an ammonium ion selective electrode. The ammonium ion electrodes used include nonactin membrane electrodes, air gap electrodes, or gas selective membrane electrodes. The systems may use either soluble or immobilized enzymes. Biological detection and decontamination systems have been developed for cyanide using the enzymes rhodanese and beta-cyanoalanine synthase, and cyanide and sulfide electrodes. Both soluble and immobilized enzymes have been used in either batch or flow systems. An aryl acylamidase enzyme extracted from Pseudomonas striata has been found to be able to hydrolyze phenyl or methyl carbamate pesticides, with methylamine detection by an air gap electrode. (Brambley-SRC)
W82-05161

UTILITY OF THE MICROTOX LUMINESCENT BACTERIAL ASSAY FOR THE RAPID ASSESSMENT OF AQUATIC POLLUTION,
Beckman Instruments, Inc., Carlsbad, CA.
A. A. Bulich.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 173-184, 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Bioassay, *Bacterial physiology, *Luminescence, *Water pollution, *Testing procedures, Toxicity, Pollutants, Effluents, Monitoring, Metals, Phenols, Alcohols, Pesticides, Aromatic compounds.

The Microtox Toxicity Analyzer is a bioassay system using luminescent bacteria which has potential as a rapid, reliable, and inexpensive method for assessing the toxicity of water samples. The system is used to determine the concentration of chemical which produces a 50% reduction in light emission for 5 min (EC50). EC50's were obtained for 20 substances, including metals, phenols, alchols, pesticides, and aromatic hydrocarbons, and these figures were compared with 24-96 h fish toxicity bioassays. A good correlation was observed between fish toxicity and luminescence reduction. Similar correlations were observed when complex effluents were used rather than pure compounds. An improved testing procedure allows a determination of EC50 to be completed in 30 min. The Microtox system appears to be a convenient reliable approach for the rapid determination of acute toxicity of water samples. (Brambley-SRC)
W82-05162

THE USE OF ALGAE AS BIOLOGICAL ACCUMULATORS FOR MONITORING AQUATIC POLLUTANTS,
Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.
S. L. Friant, and J. W. Sherman.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 185-206, 8 Fig, 3 Tab, 52 Ref.

Descriptors: *Algae, *Bioaccumulation, *Monitoring, *Water pollution, *Bioindicators, Metals, Water chemistry, Organic compounds, Water pollution source, Nonpoint pollution sources, Diatoms.

An overview is presented of possible biomonitoring uses of algae as aquatic pollutant bioaccumulators. While metals and other pollutants found in animal tissues may originate in the water column, this is the only source of the substances for algae. The uptake of metals by algae is, however, affected by pH, ligands, competition of metals, and the natural background matrix. These influences must be investigated before algae can be used for long-term monitoring. Algae (primarily diatoms) colonizing artificial substrates have been analyzed for metal uptake over long periods, in some cases up to 20 years. The colonizing period has been two weeks, after which the algae are removed from the slide and subjected to extraction procedures followed by chromatographic analysis. This method has been used to survey rivers for trace metals and trace organics. The results show that the method may be used to assess point source discharges of biologically available pollutants, and the effects of dilution and to identify chemical sinks in flowing systems, and to characterize pollutants resulting from both point and non-point sources present over wide areas. (Brambley-SRC)
W82-05163

DIRECT ANALYTICAL METHOD FOR AROMATIC COMPOUNDS IN WATER BY STEAM CARRIER GAS CHROMATOGRAPHY,
Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
K. Urano, H. Maeda, K. Ogura, and H. Wada.
Water Research, Vol 16, No 3, p 323-327, March, 1982. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Water analysis, Chromatography, Measuring instruments, *Gas chromatogrphy, *Aromatic compounds, Hydrocarbons, Chemical analysis, Wastewater treatment, Industrial wastewater.

Steam carrier gas chromatography was used to determine the presence of various aromatic compounds in water. A hydrogen flame ionization detector was used with acid washed Chromosorb P modified with 3.5 wt% phosphoric acid as a stationary solid-in-glass column. The aqueous solutions of typical aromatic compounds including mono- and di-substituted, benzenes, naphthalene and naphthol, and wastewater from an oil refinery and its treated water were used as samples in this study. The results indicated that various aliphatic and aromatic compounds in water could be directly analyzed by the SCGC method. Water samples from the oil refinery were analyzed after only filtration with 0.45 micrometer membrane. There were six or more compounds in the raw wastewater, and several compounds remained in the water after treatment. The compounds in the wastewater included methyl alcohol, ethyl alcohol, phenol, o-, m-, and p-cresols, and one unknown, which was characterized as a polar low molecular weight aliphatic compound. The wastewater treatment system being used at the refinery was effective only in removing the phenol and cresols. Thus SCGC is a useful technique for evaluating water quality and water treatment processes. (Baker-FRC)
W82-05164

EVALUATION OF METHODS FOR THE ASSAY OF RADIUM-228 IN WATER,
National Bureau of Standards, Washington, DC. National Measurement Lab.
J. R. Noyce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-178162, Price codes: A02 in paper copy, A01 in microfiche. NBS Technical Note 1137, February 1981. 18 p, 1 Tab, 38 Ref.

Descriptors: *Radium radioisotopes, *Water analysis, *Drinking water, *Radiochemical analysis, Chemical analysis, Assay, Water quality, Water pollution.

Radium-228 is ingested primarily by the drinking of water, and it is hazardous to human health. It has been found to occur in higher concentrations than radium-226 in water in contact with some geological formations. Radium-228 is difficult to assay accurately, especially at low concentrations, because it emits only very low-energy conversion electrons and low-energy beta particles. The technical literature from 1967 to May 1980 was searched for methods for assaying radium-228 in water, and these methods were evaluated for suitability as potential EPA reference methods for drinking water assays. Most of the assay methods were eliminated from consideration by applying

the following criteria: adequate sensitivity, yield determination without radioactive tracers, and a waiting time for ingrowth or decay of radionuclides in the sample of no more than 30 days. It is suggested that the EPA retain the present reference method (Krieger, 1976) but improve its decontamination factor for Y-90 and correct its chemical yield calculation. The McCurdy and Mellor (1979) method should be added as a second reference method. The two procedures complement each other. (Moore-SRC)
W82-05212

DYNAMICS OF THE NUMBER OF BACTERIA AND CONVERSION OF READILY OXIDIZABLE SUBSTANCES IN SMALL RIVERS,
Tallin Polytechnic Inst. (USSR).
A. E. Saava.
Water Resources, Vol 8, No 2, p 195-201, March-April, 1981. 3 Fig, 2 Tab, 12 Ref. Translated from Vodnye Resursy, No 2, p 144-150, March-April, 1981.

Descriptors: *Bacteria, *Indicators, *Self-purification, *Wastewater pollution, *Estonia, Streams, Biological oxygen demand, Bioindicators, Coliforms, Enteric bacteria, Temperature effects, Water temperature, Saprophytic bacteria, Water quality, Fate of pollutants.

Bacterial indicators in wastewater pollution (saprophytes, coliforms, and enterococci) were determined upstream and downstream of wastewater outfalls in small (discharge < 30 cu m per sec) unpolluted Estonian streams. Samples were also collected in winter and summer to study temperature dependence. Relationships between saprophytes, coliforms, and enterococci were found at upstream sites. In winter saprophyte numbers were positively correlated with BOD and with ammonia and nitrite concentrations. Coli index and enterococci numbers were negatively correlated with water temperature, indicating longer survival of bacteria at lower temperatures. In summer the bacterial indicators did not correlate among themselves or with chemical water quality parameters. At downstream sites in winter there were more saprophytes and enterococci than in summer. This was caused by slow dieoff of bacteria at low temperatures. There was a positive correlation between the three bacterial indicators, BOD, and chloride levels. In summer downstream samples, bacterial indicators were postively correlated with the ammonia levels and negatively correlated with dissolved oxygen. A study of bacterial population dynamics in the self-purification process showed that enterococci and E. coli 015 did not multiply in river water at temperatures of 0 to 20 C. Other E. coli strains grew rapidly at higher water temperatures, 10 to 50 C. In summer more than 95% of bacteria died within the first 12-15 hours, and microbial self-purification was completed in about 24 hours. In winter only 70% of bacterial died within the first 12 hours and 95% by the end of the second day. Equations are given, relating the coefficient of death rate of bacteria to temperature or current velocity. (Cassar-FRC)
W82-05237

CHARACTERIZATION OF INDUSTRIAL WASTES BY EVALUATING BOD, COD, AND TOC,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
D. R. Hill, and S. J. Spiegel.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2704-2708, November, 1980. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Industrial wastes, *Oxygen demand, Mathematical studies, Biochemical oxygen demand, Chemical oxygen demand, Water analysis, Oxygen, Wastewater treatment, Wastewater, Evaluation, *Onondaga, *New York.

Substantial cost and manpower could be saved if any of the three parameters BOD, TOC and COD could be accurately estimated by calculation from the analytical value of one of the others. An examination was undertaken to discern any consistent relationships between these parameters as part of an intensive industrial waste survey in Onondaga County, New York. Data for the study were generated from samples collected from 1973 through mid-1977. About 95% of the samples collected were composites over the production periods of each industry. Relationships were sought between BOD, COD, and TOC using a measurably larger data file, in some industrial waste categories, than had been reported in earlier literature. In these high-data Standard Industrial Classification (SIC) categories, the correlations were sometimes found to be within the 99% significance level, thus permitting extrapolations from only one observed value and reducing the need for and cost of continued testing. (Baker-FRC)
W82-05255

SAMPLING AND ANALYZING WATER,
J. Lehr, T. Gass, W. Pettyjohn, and J. DeMarre.
Water Well Journal, Vol 36, No 2, p 46-51, February, 1982. 1 Tab, 3 Ref.

Descriptors: *Water analysis, *Sampling, Sample preparation, Water quality, Chemical analysis, Public health, Bacteria, *Water supply, Drinking water, *Domestic water.

The process of sampling and analysis of domestic water supplies not only evaluates the cause of a particular problem but also determines the kind of treatment and the size of the equipment needed to provide clear, safe, palatable water in desired quantities. Sampling and analysis of water may also become in some localities a prerequisite for meeting local laws concerning water. A sanitary survey locates potential sources of water quality degradation in and around the point of water withdrawal and determines whether special chemical or biological tests are needed to identify potential sources of pollution. To many homeowners, the most important consideration about any water supply is its freedom from disease-producing organisms. Water must be sampled periodically and be analyzed for bacterial contamination. Various chemical elements and compounds may also be present in groundwater. The sources of these chemicals are associated with either natural processes or human activities. To obtain an adequate sample of water for either biological or mineral analysis, the objectives of the sampling must first be established. Once the purpose is established, the sample taken must accurately represent the quality of the water source. Methods for collecting, preserving, packaging, identifying, and shipping sample bottles and containers for bacteriological analysis are highlighted. (Baker-FRC)
W82-05263

SAMPLING FREQUENCY OPTIMIZATION USING A WATER QUALITY INDEX,
Oregon State Dept. of Environmental Quality, Salem.
D. A. Dunnette.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2807-2811, November, 1980. 5 Tab, 7 Ref.

Descriptors: *Water quality, *Evaluation, *Monitoring, Sampling, Mathematical equations, Water pollution control, Water analysis.

This work describes a water quality index and how it can be used in a very simple way to evaluate and upgrade present monitoring programs. While a complete and thorough theoretical statistical evaluation of an ambient water quality monitoring network is often beyond the resource capability of a state water quality control agency, use of two assumptions can simplify the statistical processes greatly. These two assumptions are: that future water quality statistical data will correlate fairly well with present data, and that data obtained in the water quality monitoring program are normally distributed, i.e., the data describes the classical bell curve. A study was made of the distribution of Oregon Water Quality Index values over a 6 year period, 1972-1977. The simplification suggested in this paper was justified, particularly when the sampling frequency evaluation is considered an interim step prior to a more rigorous evaluation. The simplified approaches to sampling frequency determination indicate a range of between 25 samples per year for a lower water quality station and 6 per year for a higher water quality station, assuming 95% confidence and 5% allowable error. It is emphasized that these sampling frequences are based on observed variability in the OWQI and indicate the number of samples required to meet the confidence and error limits imposed. (Baker-FRC)
W82-05268

METAL CONCENTRATIONS IN GUAM URBAN RUNOFF,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5B.
W82-05302

WATER QUALITY ASSESSMENT FOR AGANA SPRINGS,
Guam Univ., Agana. Water and Energy Research Inst.
T. L. Smalley, and W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224791, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 22, April 1981. 34p, 12 Fig, 4 Tab, 19 Ref, 3 Append. OWRT A-015-GUAM, 14-34-001-0112.

Descriptors: *Water quality, *Municipal wastes, *Water analysis, *Water resources development, *Guam, Water quality standards, Bacterial analysis, Chemical analysis, Wells, Groundwater availability, Groundwater contamination, Resources development, Water supply development, Evaluation, Drinking water, Potable water, Water distribution, Environmental protection, Environmental quality, Environmental policy.

This water quality study assessed the potential of Agana Springs for possible development as a municipal water source. The results indicated that water quality was sufficiently high to merit development of Agana Springs as a freshwater resource. The chemical and physical quality of the water within the impoundment was found to be high relative to the Guam EPA standards for drinking water and standing waters used for drinking water. The observed quality was also higher than many wells and surface water sources currently used by the Guam water distribution system. The observed light-to-moderate bacterial contamination (thought to be due to surface runoff and animal activities and not to contaminated groundwater) could be controlled by chlorination. The results of thirteen chemical and bacterial parameters analyzed over a five-month study are reported and discussed. It is recommended that Guam's government should attempt to obtain the Agana Springs resource for development if the Navy does not plan to develop it for its own needs. Tapping this resource would augment the northern well field with a volume equal to or greater than 4-6 high-production groundwater wells. (Zielinski-MAXIMA)
W82-05304

AUTOMATED BIOMONITORING APPLICATIONS IN REMOTE WATER QUALITY SURVEILLANCE AND TIME RATED TOXICOLOGICAL ASSAY,
Tennessee Technological Univ., Cookeville. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W82-05305

BIOLOGICAL MONITORING, PART IV - TOXICITY TESTING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05339

BIOLOGICAL MONITORING. PART V - PREFERENCE AND AVOIDANCE STUDIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05340

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FLUORESCENCE CELL DESIGN AND USE TO DETERMINE CRUDE OIL IN WATER,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Chemistry.
P. John, E. R. McQuat, and I. Soutar.
Analyst, Vol 107, No 1271, p 221-223, February, 1982. 2 Fig, 2 Ref.

Descriptors: *Fluorescence, *Oil, Crude oil, Water analysis, *Pollutant identification, Technology.

A commercial fluorescene cell was modified for use in measuring fluorescence emission from water-dispersed crude oil. A 1 cm path length quartz fluorescence cell was altered to accommodate two concentric inlet tubes and a co-linear exit tube. Maximum flow rates for this cell were 160 cu cm per sec for the sample flow and 504 cu cm per sec for the outer concentric flow. The upper flow guides were adjustable in the vertical direction, allowing establishment of laminar flow after the flow guide was lowered until coincident with the fixed exit tube. They prevented contamination of the optical surfaces. In sufficiently dilute solutions, fluorescence emission intensity for oils of differing characteristics was linearly related to the concentration in non-quenching organic solvents. This relationship was also valid for three crude oils in water, tested at concentrations up to 10 microliters per liter. (Cassar-FRC)
W82-05358

DETERMINATION OF ULTRATRACE LEVELS OF FLUORINE IN WATER AND URINE SAMPLES BY A GAS CHROMATOGRAPHIC/ATMOSPHERIC PRESSURE HELIUM MICROWAVE INDUCED PLASMA EMISSION SPECTROMETRIC SYSTEM,
Tokyo Univ. (Japan). Dept. of Chemistry.
K. Chiba, K. Yoshida, K. Tanabe, M. Ozaki, and H. Haraguchi.
Analytical Chemistry, Vol 54, No 4, p 761-764, April, 1982. 3 Fig, 4 Tab, 27 Ref.

Descriptors: *Fluorides, *Pollutant identification, Trace levels, Seawater, *Gas chromatography, Fluorine, Water analysis.

Fluoride was determined in seawater, tap water, and pond water at concentrations as low as 0.2 micrograms per ml. After extraction with trimethylchlorosilane and conversion to trimethylfluorosilane, the sample was injected into a gas chromatograph and detected by atmospheric pressure helium microwave induced plasma (MIP) emission spectrometry. The emission line of fluorine at 685.6 nm was used for detection. Results from the fluoride ion selective electrode method were comparable with those from the MIP method. Interferences of other ions were studied in samples containing 1 microgram F per ml. Aluminum at 100 micrograms per ml interfered, but the major and minor species found in seawater did not interfere at levels normally present in seawater. (Cassar-FRC)
W82-05359

SAMPLE DIGESTION PROCEDURES FOR SIMULTANEOUS DETERMINATION OF ARSENIC, ANTIMONY, AND SELENIUM BY INDUCTIVELY COUPLED ARGON PLASMA EMISSION SPECTROMETRY WITH HYDRIDE GENERATION,
National Enforcement Investigations Center, Denver, CO.
D. D. Nygaard, and J. H. Lowry.
Analytical Chemistry, Vol 54, No 4, p 803-807, April, 1982. 2 Fig, 8 Tab, 11 Ref.

Descriptors: Metals, *Wastewater analysis, Sample preparation, *Pollutant identification, *Arsenic, *Antimony, *Selenium, Spectrometry.

Persulfate digestion in acid solution followed by heating at 95C in 6M HCl was the best of five sample digestion techniques to prepare water samples for simultaneous determination of arsenic, antimony, and selenium at the microgram per liter level by hydride generation and plasma emission detection. Other, less effective, digestion procedures were nitric acid/sulfuric acid, hydrogen peroxide/sulfuric acid, hydrogen peroxide/nitric acid, and nitric acid. Test samples contained dissolved inorganic, dissolved organic, and suspended particulates. Modifications to the hydride generation apparatus allowed simultaneous generation and detection of the hydrides. Spiked and unspiked wastewater effluent samples from a variety of industrial sources and a sewage plant were analyzed for As, Sb, and Se by the method described in this paper and by the graphite furnace atomic absorption. Results from the two methods were comparable. (Cassar-FRC)
W82-05360

DETERMINATION OF METALS IN GROUNDWATERS BY TRACE ENRICHMENT AND LIQUID CHROMATOGRAPHY,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
R. M. Cassidy, S. Elchuk, and J. O. McHugh.
Analytical Chemistry, Vol 54, No 4, p 727-731, April, 1982. 1 Fig, 5 Tab, 14 Ref.

Descriptors: Trace metals, *Metals, Heavy metals, *Pollutant identification, *Path of pollutants, Chromatography, *Groundwater pollution, Water analysis, *Landfills, Cobalt, Leachates.

Trace enrichment and liquid chromatography were used to detect metal ions in groundwater at the ng or pg per ml levels. Samples of groundwater collected in and near a waste management site were enriched using an in-line cartridge containing a strong acid cation exchanger. The enriched solution was then placed in a conventional high performance liquid chromatograph gradient pumping system with variable wave-length detector. Several sample treatments were evaluated. Fuming with nitric acid and ashing were not reliable methods of releasing bound metal ions. Citrate and nitric acid equilibrations did not give quantitative recovery for total metal ion determination. Sample treatment with Co60 irradiation was the best sample treatment in this study; relative standard deviation values for the metals (Co, Ni, Cu, Zn, Pb, Mg) tested with this treatment were 2-10%. (Cassar-FRC)
W82-05361

TRACE ENRICHMENT OF DIFENZOQUAT IN WATER AND ITS DETERMINATION BY REVERSED PHASE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
Alberta Environmental Center, Vegreville.
I. Ahmad.
Analytical Letters, Vol 15, No 1, p 27-37, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Herbicides, *Chromatography, *Pollutant identification, Difenzoquat, Water analysis.

A simple, reliable, and quick method for the determination of the herbicide difenzoquat (1,2-dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate) in water samples used the reverse phase ion pair chromatographic technique. Enrichment was accomplished with a C18 SEP-PAK reverse phase cartridge, using potassium dihydrogen orthophosphate dissolved in acrylonitrile/water (50:50 by volume) as an eluant reagent. Samples were injected into the high performance liquid chromatograph with no further treatment. Ultraviolet detection was performed at 255 nm. Recoveries of the spiked samples were 88-98%. The practical lower detection limit is 2 ppb. (Cassar-FRC)
W82-05362

GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF SOME CHLORO- AND NITROPHENOLS BY DIRECT ACETYLATION IN AQUEOUS SOLUTION,
Clemson Univ., SC.
J. Mathew, and A. W. Elzerman.
Analytical Letters, Vol 14, No 16, p 1351-1361, 1981. 2 Fig, 3 Tab, 19 Ref.

Descriptors: *Nitrophenols, *Chlorophenols, *Phenols, *Pollutant identification, Water analysis, Gas liquid chromatography, Acetylation.

Trace levels of chloro- and nitrophenols in water were determined by gas liquid chromatography after direct acetylation. The derivatives were formed by adding 10 g $NaHCO_3$ to 250 ml of aqueous solution of phenol compound followed by addition of 1 ml acetic anhydride. After 2 min the derivatives were extracted twice with 10 ml methylene chloride. The extract was concentrated by a nitrogen stream for injection into the gas chromatograph. Recoveries of phenol acetates at a level of 0.8 to 40 ppb ranged from 90 to 120%. Compounds used in the study were 2,4-dichlorophenol, 2,4,6-trichlorophenol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, and 2-sec-butyl-4,6-dinitrophenol. (Cassar-FRC)
W82-05363

OVERESTIMATION OF ORTHOPHOSPHORUS CONCENTRATIONS IN SURFACE WATERS OF SOUTHERN LAKE MICHIGAN: EFFECTS OF ACID AND AMMONIUM MOLYBDATE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, S. M. Bigelow, and C. Rubitschun.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 2, p 296-304, February, 1982. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Phosphorus, Lakes, *Fate of pollutants, *Separation techniques, Phosphates, Phosphorus compounds, Water pollution sources, Molybdenum, Pollutant identification, Nutrients, *Filtration, Organic matter, Inorganic compounds, Water analysis, *Lake Michigan.

Molybdenum blue methods are thought to overestimate orthophosphorus (P04-P) levels in filtered lake water because P04-P is released from bound sources by hydrolysis. Water samples from southern Lake Michigan were analyzed to assess the accuracy of the molybdenum blue technique and to evaluate the potential effects of ammonium molybdate on soluble reactive phosphorus (SRP) determinations. Time-course hydrolysis tests showed that sizeable quantities of P04-P were released from bound sources into solution immediately after the addition of acid molybdate. Molybdate-reactive P04-P could be retained by filters or released from particulate matter into filtrates during filtration. Using the recommended exposure time of 30 sec, P04-P levels were overestimated minimally by up to 86% and ammonium molybdate increased P04-P release in filtered samples. Other tests employing up to a fourfold range in ammonium molybdate concentrations indicated that Harvey's method and the extraction procedure gave SRP values that varied two- to three-fold or more, with most of the P04-P release originating from particles in filtrates. While the chemical composition of the SRP pool in lake water is not well known, potential sources of particulate P04-P in Lake Michigan filtrates could include large organic molecules or their fragments, colloidal inorganic-organic complexes, or capsular or fibrillar material produced by microorganisms. (Geiger-FRC)
W82-05382

VARIATION IN FECAL POLLUTION INDICATORS THROUGH TIDAL CYCLES IN THE FRASER RIVER ESTUARY,
Department of the Environment, Vancouver (British Columbia). Inland Water Directorate (Pacific Region).
L. M. Churchland, G. Kan, and A. Ages.
Canadian Journal of Microbiology, Vol 28, No 2, p 239-247, February, 1982. 7 Fig, 15 Ref.

Descriptors: *Tidal rivers, *Variability, *Indicators, Fate of pollutants, *Fraser River, Estuaries, Sampling, Feces, *Coliforms, Bacteria, Shellfish farming, Coprostanol, Sterols, *British Columbia, Canada.

Four sites in the Fraser River estuary were sampled over a 24 hour period and the water analyzed for fecal pollution indicators. Maximum concentrations of fecal sterols and coliforms occurred after high tide at the station upstream of major sewage

outfalls and on the ebb or low tide at stations downstream of the sewage outfalls. Fecal coliform counts were highly correlated with coprostanol and cholesterol levels at sites near sewage plants. In summer fecal coliform counts, but not sterol concentrations, were reduced by chlorination of sewage plant effluent. Fecal sterols may serve as useful indicators of sewage pollution, especially in shellfish harvesting waters and where bacterial determinations require concentration of large volumes of water. Monitoring of fecal pollution in these waters should be done randomly and frequently enough so that the tidal variations are included. (Cassar-FRC)
W82-05384

THE DETERMINATION OF HEAVY METALS (AL, MN, FE, NI, CU, ZN, CD, AND PB) IN URBAN SNOW USING AN ATOMIC ABSORPTION GRAPHITE FURNACE,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Landsberger, R. E. Jervis, S. Aufreiter, and J. C. Van Loon.
Chemosphere, Vol 11, No 3, p 237-247, 1982. 1 Fig, 2 Tab, 31 Ref.

Descriptors: *Metals, *Snow, *Urban areas, *Pollution identification, Heavy metals, *Montreal, Quebec, Water pollution sources, Air pollution, Canada.

Snow from the island of Montreal, Quebec, contained the following average quantities of trace metals (in nanograms per g): Al, 69; Mn, 11; Fe, 40; Ni, 43; Cu, 28; Zn, 94; Cd, 6; and Pb, 8. An atomic absorption graphite furnace was used for the determinations. Analysis of enrichment factors suggested that Al, Mn, and Fe are normal components, while Ni, Cu, Zn, Pb, and especially Cd were anthropogenically derived. Total annual trace metal deposits by rain and snow in metric tons per year were at Al, 31, Mn, 5; Fe, 18; Ni, 19; Cu, 13; Zn, 42; Cd, 3; and Pb, 4. (Cassar-FRC)
W82-05397

DETERMINATION OF MUTAGENIC POTENTIAL AND ORGANIC CONTAMINANTS OF GREAT LAKES DRINKING WATER,
Department of National Health and Welfare, Ottawa (Ontario).
D. T. Williams, E. R. Nestmann, G. L. LaBel, F. M. Benoit, and R. Otson.
Chemosphere, Vol 11, No 3, p 263-276, 1982. 3 Fig, 8 Tab, 19 Ref.

Descriptors: *Mutagens, *Organic compounds, Drinking water, *Pollutant identification, Water analysis, Pesticides, Chlorinated hydrocarbons, Seasonal variation, *Great Lakes, Polyaromatic hydrocarbons, Alkylaryl phosphates, Aromatic compounds, *Canada.

Ion exchange resin extracts of municipal drinking water from 12 Great Lakes communities were tested for mutagenic potential using the Salmonella/mammalian microsome assay. The samples were also analyzed for organochlorine pesticides, organoposphate pesticides, polyaromatic hydrocarbons, trialkylaryl phosphates, and volatile organic compounds. Dose-related increases in mutagenicity were found in extracts from 11 of the 12 water supplies. Summer samples were more mutagenic than winter samples. No relationships between mutagenic activity and the presence of individual or groups of chemicals could be deduced. Polyaromatic hydrocarbon levels were higher in winter than in summer and were higher in river water than in lake water. Of the organochlorine compounds only alpha- and beta-BHC were detected. Levels were 20 and 8 ng per liter, respectively, or less. No organophosphate pesticides were detected in samples. Trialkylaryl phosphate concentrations were similar in winter and summer samples and increased through the system from Lake Superior to Lake Ontario. Volatile organics concentrations were on the order of those found in previous studies. (Cassar-FRC)
W82-05398

EFFLUENT ANALYSIS OF WASTEWATER GENERATED IN THE MANUFACTURE OF 2,4,6-TRINITROTOLUENE, 2. DETERMINATION OF A REPRESENTATIVE DISCHARGE OF ETHER-EXTRACTABLE COMPONENTS,
SRI International, Menlo Park, CA.
R. J. Spanggord, and B. E. Suta.
Environmental Science and Technology, Vol 16, No 4, p 233-236, April, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Chemical wastewater, *Trinitrotoluene, *Wastewater analysis, Cluster analysis, *Pollutant identification, Statistical analysis, Phenols, Industrial wastewater, Organic compounds, Phenols, Nitrotoluenes, Nitrobenzenes, *Explosives, Aromatic compounds.

The distribution of components in a TNT manufacturing wastewater was characterized by cluster analysis and by the 90th percentile approach. Both methods gave comparable results. The major components were 2,4-dinitrotoluene (43-49%), 2,6-dinitrotoluene (21%), and 1,3-dinitrobenzene (12-41%). Constituents comprising between 1 and 5% by either method were toluene, 2,3-dinitrotoluene, 2,5-dinitrotoluene, 3,4-dinitrotoluene, 3,5-dinitrotoluene, 1,5-dimethyl-2,4-dinitrobenzene, 3-amino-2,4-nitrotoluene, 3-amine-2,6-nitrotoluene, 4-amino-2,6-nitrotoluene, 5-amino-2,4-nitrotoluene, and 2,4,6-trinitrotoluene. Sixteen other compounds were present at less than 1%. (Cassar-FRC)
W82-05412

EFFLUENT ANALYSIS OF WASTEWATER GENERATED IN THE MANUFACTURE OF 2,4,6-TRINITROTOLUENE. 1. CHARACTERIZATION STUDY,
SRI International, Menlo Park, CA.
R. J. Spanggord, B. W. Gibson, R. G. Keck, D. W. Thomas, and J. J. Barkley, Jr.
Environmental Science and Technology, Vol 16, No 4, p 229-232, April, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Chemical wastewater, *Trinitrotoluene, *Wastewater analysis, *Pollutant identification, Industrial wastewater, Organic compounds, Phenols, Nitrotoluenes, Nitrobenzenes, *Explosives, Aromatic compounds.

Ether extracts of pretreated wastewater from the continuous trinitrotoluene (TNT) manufacturing process were analyzed by glass capillary gas chromatography to characterize the constituents. Samples were collected weekly for 1 year. A total of 32 compounds were identified. The major components, accounting for 75% by weight of the total component distribution, were 2,4-dinitrotoluene, 2,6-dinitrotoluene, and 1,3-denitrobenzene. Also present were N-nitrosomorpholine; N-morpholinoacetonitrile; mono-, di-, and trinitrotoluenes; 1,5-dimethyl-2,4-dinitrobenzene; methyl nitrophenols; amino mono- and dinitrotoluenes; toluene; 1,3,5-trinitrobenzene; 2,4-dinitro-5-methylphenol; 3,5-dinitroaniline; and nitrobenzo-nitriles. Sources of the compounds were suggested. These analyses will aid in toxicologic investigations of this wastewater. (Cassar-FRC)
W82-05413

PORTABLE WATER-WASTES LABORATORY HIGHLIGHTS BENEFITS OF NITROGEN ANALYZING SYSTEMS.
Journal of the American Water Works Association, Vol 74, No 2, p 34, 36, February, 1982.

Descriptors: *Nitrogen, *Laboratory equipment, *Kjeldahl procedure, Pollutant identification, Water analysis, *Wastewater analysis, Automation, On-site tests.

Reduced-size apparatus for measuring nitrogen has enabled the U.S. Army to equip a portable laboratory for on-site analysis of water and wastes. The new Kjeldahl systems fit on a table top, need no hood, and are well insulated. Fully automated operation allows faster processing of samples. The apparatus handles liquid and solid samples from 1 to 250 ml and 0.1 to 10 g, at N levels as low as 0.1 mg per liter. (Cassar-FRC)
W82-05437

PROCEDURES FOR ANALYZING CONTAMINANTS IN DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH.
H. J. Brass.
Journal of the American Water Works Association, Vol 74, No 2, p 107-112, February, 1982. 8 Fig, 7 Tab, 34 Ref.

Descriptors: *Organic compounds, *Water analysis, *Chromatography, Reviews, *Pollutant identification, Drinking water, Laboratory equipment, Chlorinated hydrocarbons.

Many analytical methods are available for determining organic chemicals in drinking water. Sources of contaminants may be natural (humic and fulvic acids), the treatment process (trihalomethanes), point sources (priority pollutants), and nonpoint sources (pesticides). In most cases it is necessary to quantify compounds at the ppb or ppt range. Basic steps in analysis are extraction, concentration, separation, detection and quantitation. Gas chromatography-mass spectrometry and gas chromatography with conventional detectors are useful for low to medium molecular weight compounds. Cost per sample is $100-1500 and $30-500, respectively. High performance liquid chromatography can be used to determine compositions of low to high molecular weight compounds at a cost of $50-500 per sample. Systems for measuring total organic carbon and total organic halogens are available for $9000-15,000 and $9000, respectively. The importance of a quality assurance program is emphasized. The bibliography lists many books, trade publications, and government documents which provide detailed information. (Cassar-FRC)
W82-05438

PROCEDURE FOR CALCULATING THE COMPLEX RANK INDEX OF WATER QUALITY,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova.
Hydrobiological Journal, Vol 17, No 1, p 87-90, 1981. 2 Tab, 2 Ref.

Descriptors: *Water quality, *Classification, Bacterial analysis, *Water analysis, Chemical analysis, Chemical composition, Water properties, Biological properties, *Technology, *USSR.

A method has been proposed for the rank assessment of the set of hydrochemical, bacteriological, hydrobiological and saprobiological indices embodied in the classification of surface waters. The approach of the rank processing of the data enables a quantitiative evaluation to be made of the whole set of hydrochemical hydrobiological and bacteriological indices when analyzing water quality in a water body or parts of it. For the complex assessment of the water quality of a given sample typified by the set of indices proposed in the system, the gradations of its scale are estimated in terms of rank numbers from 1 to 9 in a sequence from the most highly pure water to the most highly polluted. A rank assessment is made of each index investigated in accordance with its magnitude and position in the system. The sample is then assessed by the set of ranks. For this purpose the sum of the ranks is computed, the arithmetic mean found, and its value employed in evaluation of the sample in conformity with the gradation of the system. Since, in practice, the composition and properties of the water may come under different gradations in terms of the individual indices of the system, and may be different worth as criteria, complex evaluation using the method of rank indices enables the level of saprobicity to be established with greater certainty than on the basis of individually selected hydrochemical, hydrobiological and bacteriological indices or on the basis of their overall consideration but without the proposed method of rank processing. (Baker-FRC)
W82-05457

THE RESPONSE OF SPECIFIC CONDUCTANCE TO ENVIRONMENTAL CONDITIONS IN THE EVERGLADES NATIONAL PARK, FLORIDA,
National Park Service, Homestead, FL.
M. D. Flora, and P. C. Rosendahl.

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Water, Air and Soil Pollution, Vol 17, No 1, p 51-59, 1982. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Environment, *Monitoring, Everglades, Florida, Specific conductivity, Conductivity, Evapotranspiration, Seasonal variation, Water quality.

A study was conducted to document present day isoconductivity patterns found throughout Shark Slough under both wet season and dry season conditions, relate these patterns to quantitative change in the delivery of canal water to the slough and geograhic proximity to the S-12 delivery site, and assess the short-term response at a single site to short term environmental changes such as extreme storm events. From October 1978 through September 1979, hourly stage and specific conductance were recorded at a station in central Shark Slough, about 17 km south of the S-12 water delivery structures. A comparative analysis of rainfall input and S-12 water delivery indicates that the study period can be subdivided into 8 hydrologic periods of differing water input character. Factors emerging as important in determining isoconductivity patterns in Shark Slough included the quality and quantity of surface water delivered to the slough, the quantitiative realtionship between the amount of surface water delivery and the amount of direct precipitation, and the effects of interrupted sheet flow within the slough during seasonal drawdown periods. The temporal trend from year to year is primarily dependent on the quality of the surface water delivered to the Slough and can be expected to continue to increase should the specific conductance and cation concentration of the delivery water continue to increase. Minimum and maximum extremes in specific conductance are likely to vary annually, depending on regional rainfall and hydrologic conditions. In a system as complex as the Everglades, it is important to maintain a continuing monitoring program both to detect any change in water quality and to differentiate between changes occurring in response to natural conditions and those produced by human actions. (Baker-FRC)
W82-05464

MUTAGENS, CARCINOGENS AND THE WATER CYCLE,
Severn-Trent Water Authority (England).
R. J. Tye, and W. M. Waite.
Water Pollution Control, Vol 80, No 5, p 600-613, 1981. 4 Fig, 17 Ref.

Descriptors: *Pollutants, *Carcinogens, *Mutagens, Water pollution, Public health, Measurement techniques, Pollutant identification.

Epidemiological studies on the incidence of various types of cancer in genetically similar populations in different environments have indicated that over 80% of cancers have some environmental links. The recent development of simple laboratory tests for mutagenesis provides a powerful tool for the tentative identification of potential carcinogens. Mutagenesis is the induction of inheritable changes in the genetic material of a cell. Since studies have shown that over 90% of carcinogens are mutagens, identifiable mutagens should be investigated further to determine whether or not they are also carcinogenic. Epidemiological techniques and laboratory studies have been used to investigate the possible mutagenic and carcinogenic effects of water sources and the pollutants associated with them. The Severn-Trent Water Authority Mutagenicity Unit has investigated modified bacterial test systems which permit the testing of large sample volumes, increasing the sensitivity of any preliminary screening test. The Unit has identified about 200 organic chemicals in water samples. The haloforms and the polycyclic aromatic hydrocarbons are of greatest interest. Mutagenic responses of these organic chemicals can be induced by a wide range of both raw and treated waters using a tube-fluctuation test procedure without prior concentration. However, before work on the fractionation and identification of active organics can begin, it is desirable to concentrate the organic fraction in the waters. Some concentration techniques are discussed. Mutagenesis testing can be applied either to natural water samples or to material shown to be present in waters by analytical techniques and subsequently tested as pure substances. Possible future applications of mutagenesis testing are described. (Carroll-FRC)
W82-05468

A METHOD FOR THE DETERMINATION OF SULPHIDES IN WATER, SEWAGE AND EFFLUENTS,
Southern Water Authority (England).
D. Ballinger, and A. Lloyd.
Water Pollution Control, Vol 80, No 5, p 648-654, 1981. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Sulfides, *Pollutants, *Measurement techniques, Water pollution, Effluents, Wastewater, Calibrations.

A previous review of existing methods for the measurement of sulfides concluded that none of the available methods was entirely satisfactory. Major complaints included the failure of the methods to determine sulfides selectively and the need to utilize time-consuming procedures. A sulfide analysis procedure for use on sewage, water, and effluents is proposed which attempts to overcome these problems. The method is designed to identify dissolved inorganic sulfides, including undissociated hydrogen sulfide, hydrosulfide, and sulfide ions, as well as total sulfides, including dissolved inorganic sulfides and other compounds liberating hydrogen sulfide from a cold solution containing 0.5 M hydrochloric acid. The procedure involves bringing the sample to solution vapor equilibrium in a closed flask under controlled conditions, determining the concentration of hydrogen sulfide vapor by means of Draeger tubes, and using a calibration graph to relate the concentration of hydrogen sulfide vapor to the concentration in solution. This procedure allows rapid analysis of sulfide in a wide range of sample types. No physical pretreatment is required to distinguish dissolved sulfide from total sulfide, since such a separation cannot be achieved without significant loss of hydrogen sulfide from solution. The technique was developed for use as a field analysis procedure, and the published data for precision and accuracy may be acceptable for routine environmental analyses. (Carroll-FRC)
W82-05477

ORGANIC GROUPS AND MOLECULAR WEIGHT DISTRIBUTION IN TERTIARY EFFLUENTS AND RENOVATED WATERS,
Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W82-05480

A NEW SENSITIVE AND SIMPLE SPOT TEST FOR THE DETECTION OF TERTIARY AMINE POLLUTANTS IN WATER,
Z. H. Coll. of Engineering and Technology, Aligarh (India).
M. Qureshi, H. S. Rathore, and A. M. Sulaiman.
Water Research, Vol 16, No 4, p 435-440, April, 1982. 1 Fig, 4 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Organic compounds, *Organic pesticides, *Toxins, Pesticides, Aminotriazole, Saline water, Industrial wastes, Separation techniques, Organic solvents, Solvents, Detection limits, Water analysis.

A simple, inexpensive and specific spot test for the detection of tertiary amines by citric acid in acetic anhydride has been reported. These compounds frequently occur as water pollutants from the use of pesticides or in industrial wastes. An attempt was made to modify this procedure for the detection of organic pollutants in water. The test solution was prepared in acidic, basic, or saline waters, and citric acid impregnated filter paper was used as the reagent. The detection limits for the pesticides amitrol, azobenzene, bavistin and calixin were 0.04, 40, 2, and 3.2 micrograms/drop, respectively. For the toxins 2,4-lutidine, 2,6-lutidine, nicotinic acid, beta-picoline, and quinoline, the detection limits were 4, 100, 0.04, 0.4 and 100 micrograms/drop, respectively. The spot test coupled with solvent extraction can be used to detect the presence of calixin and azobenzene in water, and is simple enough for field use. (Geiger-FRC)
W82-05483

HIGH RESOLUTION ALPHA SPECTROSCOPY BY LIQUID SCINTILLATION TECHNIQUES,
Maine Univ. at Orono. Dept. of Physics and Astronomy.
E. G. Coombs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236563, Price codes: A03 in paper copy, A01 in microfiche. M. S. Thesis, August, 1980. 39 p, 15 Fig, 2 Tab, 1 Ref. OWRT B-017-ME(4).

Descriptors: *Radioactivity techniques, *Spectroscopy, *Radium radioisotopes, *Pollutant identification, *Water analysis, Uranium radioisotopes, Radioisotopes, Radiochemical analysis, Radioactivity, Radioactive wastes, Pollutants, Pollution load, Environmental protection, Population exposure, Water pollution control, Groundwater pollution, Water quality, Environmental effects.

The use of high-resolution liquid scintillation spectroscopy is described as an inexpensive and rapid method for the determination of radium-226 (an identified health hazard) and other alpha-emitting radionuclides in environmental water samples. Procedures are reported for measuring radium-226, uranium-238, and uranium-234, affording positive identification, high sensitivity due to pulse shape discrimination, and rapid sample preparation. No environmental water samples examined were found to have measurable levels of radium-226. Nonetheless, radium-226 can be detected, measured, and positively identified down to a level of 4 pCi/liter, with a recovery efficiency of 47%. The method was optimized for environmental radiation measurements by: optimizing the energy resolution; reducing the background by use of pulse shape discrimination; and optimizing the scintillation fluor. Since the extractant used will extract any actinide series element, the instrumentation and techniques developed can be applied to other areas (e.g., mesurement of plutonium and uranium in environmental effects studies of the nuclear fuel cycle). Measurements of the polonium 218, 214, and 210 isotopes, and radon-222, were also made. With the present energy resolution, an alpha energy identification to within 0.4 MeV is possible. (Zielinski-MAXIMA)
W82-05541

CLASSIFICATION AND MANAGEMENT OF WETLANDS IN THE WESTERN KENTUCKY COAL FIELD,
Kentucky University, Lexington Water Resources Research Inst., KY.
For primary bibliographic entry see Field 5C.
W82-05549

A PRAGMATIC APPROACH TO WATER QUALITY MICROBIOLOGY IN A CLEAN RIVER AREA,
North West Water Authority (England), Rivers Div.
G. Dussart.
Environmental Pollution, Series A, Vol 27, No 2, p 97-118, February, 1982. 6 Fig, 4 Tab, 38 Ref.

Descriptors: *Water quality, *Monitoring, Rivers, England, Statistical analysis, Data acquisition, Mathematical studies, Microorganisms, Bioindicators, Ecosystems, Aquatic organisms.

A description is offered of how the microbiota may be used for pollution assessment and results are presented of a typical comparative investigation. The utility of canoical correlation analysis was evaluated. Three river systems in northwest England were evaluated using this technique. In the Ehen, nitrite, phosphate and flow appear to relate to the distribution of diatoms, nomotile green algae and filamentous algae. While a landfill leachate problem exists causing high iron concentrations, the correlation does not identify iron as a significant variable. For the Derwent, phosphate

and biochemical oxygen demand are related to the distribution of most groups except for the blue-green algae. For the nutrient-poor Irt, physical, rather than chemical, variables are important. At a more sophisticated level, canonical correlation may be a robust and useful method of examining the factors which affect the distribution of groups of microorganisms in river ecosystems. (Baker-FRC)
W82-05575

TRACE DETERMINATION OF AS(III) AND AS(V) IN NATURAL WATERS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
F. G. Bodewig, P. Valenta, and H. W. Nurnberg.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 311, No 3, p 187-191, March, 1982. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Arsenic, Pollutant identification, Water analysis, Organic matter, Trace metals, Anodes.

Arsenic was determined at trace levels in estuarine water and seawater samples. The method involved depositing arsenic onto a rotating gold electrode at a potential of -0.3V vs. a normal calomel electrode, followed by anodic stripping. For a deposition time of 4 min the detection limit was 0.2 micrograms per liter. As(5+), which is electroinactive, was first reduced to As(3+) by gaseous SO2. Other metals at levels usually found in polluted waters did not interfere. Destroying organic matter with hydrogen peroxide-ultraviolet radiation was not necessary in most samples, but did improve accuracy. At As levels of 2-5 micrograms per liter the relative standard deviation was 6-10%. Complete analysis of a sample required 30 min without the As(5+) reduction step and 75 min with the reduction step. (Cassar-FRC)
W82-05580

PROCEDURE FOR INVESTIGATING METALLIC ION COMPLEXING IN NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik.
Hydrobiological Journal, Vol 16, No 6, p 50-51, 1980.

Descriptors: *Chelation, *Metals, Pollutant identification, Organic matter, Chemical analysis, Natural waters, Fate of pollutants, Chemical composition.

A method for determining mean composition and stability of metal complexes in natural waters is described. It does not give qualitative and quantitative composition. Instead, it measures the concentration of ions not incorporated in complexes (using methods such as ionometric measurements, voltamperometric measurements) and hetotal concentration of complex-forming substances, expressed in terms of the concentration of the metal under investigation. (Cassar-FRC)
W82-05595

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT, I. RESIDUES OF ORGANOCHLORINE PESTICIDES,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-05620

ORGANOCHLORINE RESIDUES IN SUSPENDED SOLIDS COLLECTED FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES 1974-1977,
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
For primary bibliographic entry see Field 5B.
W82-05635

ORGANIC CONTAMINANTS IN THE SUSPENDED SEDIMENTS OF THE NIAGARA RIVER,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-05636

GEOCHEMICAL PATHWAY STUDIES OF HEAVY METALS IN LAKE SEDIMENTS FROM THE SUDBURY-TEMAGAMI AREA, ONTARIO,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W82-05640

A LAND RESOURCE INFORMATION SYSTEM (LRIS) FOR WATER QUALITY MANAGEMENT IN THE LAKE ERIE BASIN,
Corps of Engineers, Buffalo, NY.
For primary bibliographic entry see Field 7B.
W82-05662

INVESTIGATING POTENTIAL WATER CONTAMINATION BY PETROLEUM-ASPHALT COATINGS IN DUCTILE-IRON PIPE,
Southern Research Inst. Birmingham, AL. Analytical and Physical Chemistry Div.
H. C. Miller, W. J. Barrett, and R. H. James.
Journal of the American Water Works Association, Vol 74, No 3, p 151-156, March, 1982. 2 Fig, 11 Tab, 7 Ref.

Descriptors: *Asphalt, *Pipes, *Polyaromatic hydrocarbons, Pollutant identification, Coatings, Aromatic compounds, Fate of pollutants, Paint, Water pollution sources.

Petroleum asphalt seal coatings inside ductile iron water pipes contributed no significant polyaromatic hydrocarbons (PAH) to the water supply under worst-case conditions in a laboratory test. The experimental apparatus circulated clean water through 10.3 m of 150 mm production line pipe in a closed system. The interior of the pipe was coated with asphalt paint according to ANSI specification A21.4. Flange faces were also coated. The pipe was aged for 1 month after coating. Linear velocity of the water was 0.9 m per sec. Water samples were taken at intervals up to 232 hours and analyzed for benzo(a)pyrene and five other common PAH included in the WHO drinking water standards. The analytical method used was high pressure liquid chromatography with fluorescence detection and gas chromatography-mass spectrometry. The sum of the concentrations of the six specified PAH did not exceed 10 ng in any of the water samples. This was only 5% of the WHO recommended maximum of 200 ng per liter. (Cassar-FRC)
W82-05676

IONIC COMPOSITION OF GROUND WATERS AND THEIR DISTRIBUTION IN KARNAL DISTRICT (HARYANA),
Central Soil Salinity Research Inst., Karnal (India).
R. C. Sharma.
Annals of Arid Zone, Vol 20, No 3, p 209-214, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality, *Saline water, *Irrigation water, Water analysis, Karnal District, *India, Conductivity, Sodium, Chemical composition, Pollutant identification, Arid lands.

Water quality in the Karnal district, India, area 8007 sq km, was evaluated by collecting 222 groundwater samples from 107 villages. Analyses included electrical conductivity (EC), cations (Ca, Mg, Na, K) and anions (carbonate, bicarbonate, chloride, sulfate). Five classes of water quality were designated: Class I, EC < 2000 micromhos per cm, residual sodium carbonate (RSC) < 5 me per liter, considered safe for irrigation; Class II, EC < 2000 micromhos per cm, RSC > 5 me per liter, usable as irrigation water if soluble Ca salts are added periodically; Class III, EC 2000-4000 micromhos per cm, RSC < 5 me per liter, usable as irrigation water on light soils or with salt-tolerant crops; Class IV, EC 2000-4000 micromhos per cm, RSC > 5 me per liter, usable as irrigation water by mixing with better quality water and application of gypsum; Class V, EC > 4000 micromhos per cm, usable as in Class IV. About 84% of the waters were classified low sodium and 16% high sodium. (Cassar-FRC)
W82-05721

A SIMPLE SPECTROPHOTOMETRIC TECHNIQUE FOR THE DETERMINATION OF PENTACHLOROPHENOL IN WATER,
Battelle New England Marine Research Lab., Duxbury, MA.
R. S. Carr, P. Thomas, and J. M. Neff.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 477-479, 1982. 1 Tab, 9 Ref.

Descriptors: *Phenols, *Pentachlorophenol, *Water analysis, Organic compounds, *Pollutant identification, Spectrophotometry.

A simple, relatively sensitive, reliable spectrophotometric method for quantifying pentachlorophenol (PCP) in water is described. After HCl treatment to release PCP from salts, the sample is extracted with 10 ml chloroform. Then 2 ml of 200 mM NaOH is added to the chloroform extract and the sample vortexed for 30 sec. Absorbance of the resulting aqueous fraction is measured at 320 nm with a Pye Unicam SP 1800 double beam ultraviolet spectrophotometer. Detection limit varies from 5 to 50 ppb for samples of 1000 ml and 100 ml, respectively. There is a linear relationship between PCP concentrations from the detection limit up to 5 ppm, near the saturation limit of PCP in seawater. Extraction efficiencies are 92-102%. (Cassar-FRC)
W82-05725

USE OF ALGAL FLUORESCENCE FOR AN AUTOMATED BIOLOGICAL MONITORING SYSTEM,
Institute for Water Research Ltd., Dortmund (Germany, F. R.).
G. Benecke, W. Falke, and C. Schmidt.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 385-395, 1982. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Fluorescence, *Algae, *Bioassay, *Pollutant identification, Herbicides, Photosynthesis, Monitoring, Automation.

A bioassay procedure uses algal fluorescence in stream quality monitoring. Test organisms are Scenedesmus or Chlorella. Conditions and pollutants which retard photosynthesis produce variations in the fluorescence curve of plant materials. A normal fluorescence curve shows an increase in height with time, followed by a slight depression, then a second increase. Photosynthetic inhibitors such as herbicides change fluorescence intensity and produce curve leveling and changes in the first phases of the curve. In the fluorescence measurement cell agal cultures mixed into the filtered water sample under investigation are kept dark for a specified period, then exposed to light. In this work an exposure time of 0.5 sec, 150 watt light source, and dark phase of 10 min are used. The light passes through a blue filter, through the cell, and through a red filter with a transmission maximum at 660 nm. A photomultiplier amplifies the signal and a curve is recorded on the oscillograph. For a permanent record, the curve can be photographed. (Cassar-FRC)
W82-05728

SNOW CONTAMINATION BY HEAVY METALS AND SULPHUR IN CRACOW AGGLOMERATION (SOUTHERN POLAND),
Academy of Mining and Metallurgy, Kracow (Poland). Inst. of Environmental Protection.
For primary bibliographic entry see Field 5B.
W82-05783

INDICATOR BACTERIA SURVIVAL UNDER LABORATORY CONDITIONS,

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Marquette Univ., Milwakee, WI. Dept. of Civil Engineering.
A. E. Zanoni, and J. T. Fleissner.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 500-503, May, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Indicators, *Bacteria, *Survival, Pollutant identification, Fate of pollutants, Coliforms, Die-off coefficients, Sampling, Incubation, Wastewater, Population dynamics, Mixing.

Jug tests (in vitro) of indicator bacteria survival were performed using three natural waters, Lake Michigan harbor and beach and Milwaukee River, seeded with settled sewage supernatant wastewater. The 3 incubation methods were: quiescent (no disturbance of jug contents), prior mix (vigorously mixed just prior to sampling), and constant mix. Jugs containing 15 liters of water were incubated at 20 C in a dark closet. No matter how the treatment of samples was varied, the population of bacteria peaked at 1 day after seeding. Significant differences in bacterial survival over a 9-10 day period were seen with the three incubation methods, with the three natural waters, with reseeding every 7 days, and with seed concentrations of 0.17-1%. These results suggest that jug tests should not be used to establish die-off coefficients for indicator bacteria. (Cassar-FRC)
W82-05853

VOLATILE CONSTITUENTS OF THE PRODUCED WATER EFFLUENT FROM THE BUCCANEER GAS AND OIL FIELD,
Houston Univ., TX. Dept. of Biochemical and Biophysical Sciences.
B. S. Middleditch.
Journal of Chromatography, Vol 239, p 159-171, 1982. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Hydrocarbons, Gas chromatography, Industrial wastes, Alkanes, Volatility, Mass spectrometry.

A procedure is presented for the examination of some 200 volatile liquid hydrocarbons in effluents. The examination is performed on Tenax gas chromatography using an automated purge and trap device and the volatile constituents are then examined by combined gas chromatography-mass spectrometry. Using a bonded-phase fused-silica column, these 200 compounds are resolved and then characterized with the aid of several data manipulation techniques. While the n-alkanes are the individual compounds found in highest concentration, the alkylaromatic hydrocarbons comprise a significant proportion of the total hydrocarbons. (Baker-FRC)
W82-05874

5B. Sources Of Pollution

BORON STATUS OF BERLIN WATERS (BORSTATUS BERLINER GEWASSER),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Okologie.
For primary bibliographic entry see Field 5A.
W82-04767

ACID PRECIPITATION. 1. CAUSES AND CONSEQUENCES,
Environmental Law Inst., Washington, DC.
For primary bibliographic entry see Field 5C.
W82-04771

CHEMICAL FRACTIONATION OF HEAVY METALS IN WASTEWATER-AFFECTED SOILS,
Chile Univ., Santiago. Dept. of Chemistry.
E. B. Schalacha, M. Morales, I. Vergara, and A. C. Chang.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 175-180, February, 1982. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Wastewater irrigation, *Heavy metals, *Fate of pollutants, Metals, Copper, Zinc, lead, Chromium, Nickel, Manganese, *Santiago, *Chile Irrigation, Accumulation, Soil chemistry.

Agricultural soils irrigated for 50 years with wastewaters from Santiago, Chile, contained higher levels of extractable heavy metals than soils irrigated with river water. Three extraction methods were used. Each obtained different proportions of soluble, exchangeable, organically bonded, precipitated, adsorbed, occluded, and primary and secondary minerals. Total concentrations of metals (micrograms per g) in contaminated soils were: Cu, 127-183; Zn, 157-315; Pb, 59-64; Cr, 13-74, and Ni 23.5-24.2. In uncontaminated soils metal levels (micrograms per g) were Cu, 61-175; Zn, 94-140; Pb, 21-46; Cr, 4.5-11; and Ni, 18-25. Natural levels of Mn were high in both contaminated and uncontaminated soils. Extractable fractions varied from 48 to 169% in contaminated soils and 21-60% in uncontaminated soils. Although the metals in nonliable form (organic for Cu and inorganic precipitates for Zn) reduce the leaching potential, a shift in chemical equilibrium can mobilize the metal into plant-available forms. (Cassar-FRC)
W82-04781

ACID PRECIPITATION IN HISTORICAL PERSPECTIVE,
North Carolina State Univ. at Raleigh.
E. B. Cowling.
Environmental Science and Technology, Vol 16, No 2, p 110A-123A, February, 1982. 1 Fig, 3 Tab, 142 Ref.

Descriptors: *Acid rain, *Reviews, Rainfall, Air pollution, Fallout, Precipitation, Sulfur dioxide, Sulfuric acid, *Water pollution sources, History.

This article reviews several steps in the transformation of the concepts of acid precipitation from the domain of scientific curiosity to the domain of public concern and debate. An historical resume is presented in tabular form of the progress that has been made toward understanding the phenomena connected with man's influence on the chemical climate of the earth and their biological consequences. Contributions are presented in the chronological order of their occurrence, whether or not the work was recognized or accepted at the time. The names of the major scientists, the country in which the research was conducted, and the principal contribution to science or public affairs are presented, with appropriate references when possible. Many features of the acid rain phenomenon were first discovered in the mid-1800s in and around the city of Manchester, England. Contemporary concepts about acid precipitation and its environmental effects originated in three seemingly unrelated fields of science: limnology, agriculture and atmospheric chemistry. Concern about acid precipitation and its ecological effects in North America developed first in Canada and later in the United States, initially centering on the effects of sulfur dioxide exposure and associated acid precipitation and heavy metal deposition in the vicinity of metal smelting and sintering operations, especially near Sudbury, Ontario. (Baker-FRC)
W82-04807

VOLATILIZATION RATES OF INTERMEDIATE AND LOW VOLATILITY CHEMICALS FROM WATER,
SRI International, Menlo Park, CA.
J. H. Smith, D. C. Bomberger, Jr., and D. L. Haynes.
Chemosphere, Vol 10, No 3, p 281-289, March, 1981. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Organic compounds, *Volatility, *Mass transfer, *Fate of pollutants, Phenols, Aromatic compounds, Evaporation, Model studies.

A laboratory procedure for measuring the gas and liquid phase mass transfer coefficients and volatilization rate constants was developed. This method applies to compounds of intermediate and low volatility. The basic procedure for measuring volatilization rates was to prepare a saturated or 10 ppm solution of the chemical, whichever was lower. The oxygen reaeration rate characterized the liquid phase turbulence, and the evaporation rate of water characterized the gas phase turbulence. Data for naphthalene, anthracene, 2,4-dinitrophenol, and 1,3-dinitrobenzene were listed. This model was also used to predict the volatilization rate of the 144 organic chemicals on the EPA priority pollutant list in a natural water body. (Cassar-FRC)
W82-04817

PIXE TRACE ELEMENT ANALYSIS OF AN AQUATIC PLANT AS INDICATOR OF HEAVY METAL POLLUTION,
Tokyo Univ. (Japan).
For primary bibliographic entry see Field 5A.
W82-04818

RECENT TRENDS OF BIOCIDES IN PIKES OF THE LAKE PAIJANNE,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04819

USE OF THE PARTITION COEFFICIENT AS AN INDICATOR OF BIOACCUMULATION TENDENCY OF DYESTUFFS IN FISH,
Ecological and toxicological Association, Basel (Switzerland).
R. Anliker, E. A. Clarke, and P. Moser.
Chemosphere, Vol 10, No 3, p 263-274, March, 1981. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Dyes, *Fish, *Bioaccumulation, *Partition coefficients, Solubility, Fate of pollutants, Accumulation, Organic compounds, *Chemical wastewater.

The partition coefficient in n-octanol/water is a useful indicator of the bioaccumulation tendency of synthetic organic dyestuffs in fish. Fish bioaccumulation, data, obtained according to experimental procedures specified by the Japanese auhtorities under the 1974 Chemical substances Control Law, was produced by member companies of the Ecological and toxicological Association of the Dyestuffs Manufacturing Industry. Partition coefficients were determined experimentally by the shake flask method and were calculated by one of three methods, depending on the chemical sructure of the dyestuff. Tables list the fish bioaccumulation factors and the experimental and calculated partition coefficients for 74 dyes. Substances with experimental partition coefficients of < 1000 have bioaccumulation factors < 100 and need not be subjected to expensive fish accumulation tests. Since the partition coefficients cannot be determined experimentally for highly lipophilic or hydrophilic dyestuffs, the calculated partition coefficient provides a satisfactory alternative approach. (Cassar-FRC)
W82-04820

UNUSUAL POLYHALOGENATED CHEMICAL RESIDUES IDENTIFIED IN FISH TISSUE FROM THE ENVIRONMENT,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W82-04822

ANALYSIS OF MARINE SEDIMENT, WATER AND BIOTA FOR SELECTED ORGANIC POLLUTANTS,
Texas A and M Univ., College Station. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04823

BIOTRANSFORMATION OF N-PHENYL-BETA-NAPHTHYLAMINE TO BETA-NAPHTHYLAMINE IN A LABORATORY SLUDGE SYSTEM,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
Y. Ku, and G. Alvarez.
Chemosphere, Vol 11, No 1, p 41-46, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Wastewater treatment, Npahthylamine, Biodegra-

dation, Sludge, *Activated sludge process, *Carcinogens, Microorganisms, Laboratory tests.

The purpose of this study was to determine whether beta-naphthylamine (BNA) is produced from N-phenyl-beta-naphthylamine (PBNA) by sludge microorganisms under laboratory conditions. The activated sludge was obtained from a local sewage treatment plant in Lorton, Virginia, and used within 1 hr of receipt. High concentrations of PBNA apparently inhibited the growth of the microorganisms or their degradative abilities. Large amounts of BNA were found in the aqueous phase, suggesting that further biodegradation of BNA is limited. A steady rate of conversion of PBNA to BNA was maintained throughout a 36 hr period of study. It was concluded that, due to the biotransformation of PBNA to BNA, a potent cacinogen in humans, BNA may well be released to the aquatic environment if PBNA enters sewage treatment plants. (Baker-FRC)
W82-04824

CONTENTS OF CHLORDANE-, PCB- AND DDT-COMPOUNDS AND THE BIOTRANSFORMATION CAPACITY OF FISHES IN THE LAKE AREA OF EASTERN FINLAND,
Finland Technical Research Center, Espoo.
For primary bibliographic entry see Field 5A.
W82-04827

BIODEGRADATION OF 14C-TRIS(2,3-DIBROMOPROPYL) PHOSPHATE IN A LABORATORY ACTIVATED SLUDGE SYSTEM,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
For primary bibliographic entry see Field 5D.
W82-04833

PHOTOLYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,
SRI International, Menlo Park, CA.
R. Mill, W. R. Mabey, B. Y. Lan, and A. Baraze.
Chemosphere, Vol 10, No 11/12, p 1281-1290, November/December, 1981. 1 Fig, 5 Tab, 13 Ref.

Descriptors: *Degradation, *Aromatic hydrocarbons, *Solar radiation, *Fate of pollutants, Photolysis, Polycyclic aromatic hydrocarbons, Organic compounds, Humic acids, Kinetics.

Photolysis of 8 polycyclic aromatic compounds and heteroatom analogs was studied in a merry-go-round reactor at wavelengths of 313 and 366 nm as well as in broad spectrum light at $>$ 300 nm and sunlight. Quantum yields (all much less than 1), rate constants, and half lives (from a few minutes to several days) were calculated as a fuction of time of year at 40 degrees north latitude. Ratios of summer to winter rate constants were 25 for benzo(b)thiophene, 7.2 for quinoline, and 2-5 for the other compounds, benz(a)anthracene, benzo(a)pyrene, benzo(f)quinoline, 9H-carbazole, 7H-dibenzo(c,g)carbazole, and dibenzothiophene. Photolysis rates were variably affected by addition of dissolved humus and/or oxygen. No obvious relationships between structure and quantum yield were noticeable. (Cassar-FRC)
W82-04835

AUTOMATIC CONTROL OF THE DISCHARGE OF RADIOACTIVE SUBSUBSTANCES FROM LIGHT WATER NUCLEAR POWER PLANTS OF THE PRESSURIZED WATER REACTOR TYPE INTO FLOWING STREAMS WITH SPECIAL REFERENCE TO THE UNTERWESER NUCLEAR POWER PLANT,
Wasserwirtschaftsamt Brake (Germany, F. R.).
For primary bibliographic entry see Field 5E.
W82-04839

MOVEMENT OF DIFFUSE SOURCE POLLUTANTS IN SMALL AGRICULTURAL WATERSHEDS OF THE GREAT LAKES BASIN,
Michigan Agricultural Experiment Station, East Lansing.
R. K. Hubbard, A. E. Erickson, B. G. Ellis, and A. R. Wolcott.
Journal of Environmental Quality, Vol 11, No 1, p 117-123, January-March, 1982. 2 Fig, 4 Tab, 30 Ref.

Descriptors: *Runoff, *Agricultural watersheds, Watersheds, *Fertilizers, Agricultural chemicals, Water pollution sources, Water quality, Rainfall-runoff relationships, Erosion, Nitrogen, Phosphorus, *Soil erosion, Canopy, Throughfall, *Agricultural runoff.

Total losses of sediment, nitrogen and phosphorus and the nitrogen and phosphorus distribution in runoff waters and sediments were investigated over a two year period on a small agricultural watershed in the Great Lakes Basin region. High rates of fertilizer application had been made to the area, which was planted to corn or soybeans. During the study period, two events equaled or exceeded the 20 year expectancy in rainfall intensity, amount, and potential for erosion. Of the sediment lost, 99% was removed during 11 months, and 64-86% was lost during a single April Storm. Total sediment, nitrogen, and phosphorus losses during the period were, respectively, 19.213, 64.9, and 31.5 kg/ha for one watershed and 36.821, 72.8, and 41.2 kg/ha for the other. Evaluation of nitrogen and phosphorus distributions in the sediment and water phases respectively showed that 70-95% and 90-98% of these were carried in sediments, except during winter months. The water phase carried 80% of the nitrogen and 33% of the phosphorus during the winter. The study showed the sediments were enriched in total nitrogen but not in extractable phosphorus relative to soils. Microrelief imposed planted ridges and plant stalks or stubble retarded cross row runoff. Greater runoff was observed on the longer and steeper east-west slope of one watershed. Textural discontinuities in the upper parts of the watersheds promoted lateral seepage, resulting in emergent interflow on intermediate slopes, particularly during winter and early spring thaws. (Baker-FRC)
W82-04856

STREAM TRANSPORT OF NUTRIENTS THROUGH A WETLAND,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
J. H. Peverly.
Journal of Environmental Quality, Vol 11, No 1, p 38-43, January-March, 1982. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Wetlands, *Nutrient removal, Nitrogen, Phosphorus, Streams, Potassium, Calcium, Carbon, Seasonal variations, Water quality, Runoff, Nonpoint pollution sources, Pollution load, Water pollution sources, *Nutrients, Sedimentation, Organic soils.

A study was conducted to measure the transport of nutrients downstream from cultivated organic soil inputs and to determine the effect of managed wetlands on the creek load downstream. Oak Orchard Creek, just north of the city of Batavia in Genesee County, New York, was the study site. The Creek flows to the northeast a few kilometers through cultivated upland before entering the 3,000 ha Elba Muckland. Water samples were taken from the middle of the stream, about 15 cm below the surface and upstream of the road bridges. Samples were taken biweekly except during times of ice cover. The Oak Orchard Creek system is close to equilibrium for nitrogen and phosphorus movements, with net differences between years in gains and losses depending on quantity and timing of water movement. This wetland did not, therefore, remove significant amounts of nitrogen or phosphorus from water flowing through it, and actually increased the quantities of potassium, calcium, and carbon in the water over the 2 year study period. Highest loading was associated with highest flows, which occur in the winter and spring. Inorganic nitrogen levels in the outflow from the wetlands may fall below phosphorus levels during July and August as a result of plant utilization and denitrification losses. Biological processes downstream may be nitrogen-limited during the late summer. (Baker-FRC)
W82-04857

EFFECT OF SOIL SLOPE AND RAINFALL CHARACTERISTICS ON PHOSPHORUS IN RUNOFF,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
L. R. Ahuja, A. N. Sharpley, and O. R. Lehman.
Journal of Environmental Quality, Vol 11, No 1, p 9-13, January-March, 1982. 5 Fig, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Phosphorus, *Chemical composition, *Topography, Soil types, Soils, Soil structure, Runoff, Kinetics, Slopes, Storm runoff, *Phosphorus runoff.

Objectives of this study were to investigate, under controlled laboratory conditions, the effect of slope length, percent slope, soil cover and storm size on average solution phosphorus concentrations of runoff and to relate these effects to the kinetic mechanism of phosphorus release as expressed in a given equation. The results demonstrated that the concentration of solution phosphorus in runoff water is appreciably influenced by slope length, degree of slope, soil cover, and storm size. The degree of slope and soil cover primarily influence the effective soil mass that interacts with rainfall and runoff waters, while the slope length influences both the soil mass and water/soil ratio by determining the overland flow depths and velocities along the slope. The effect of storm size on average phosphorus concentration is a result of the kinetics of phosphorus desorption. The experimental data obtained so far on the influence of the above factors on soil phosphorus release in runoff seem to fit in to the conceptual framework of the equation. However, further work is needed on longer slopes and under field conditions to develop a working model. (Baker-FRC)
W82-04859

WATER QUALITY IN A STREAM RECEIVING DAIRY FEEDLOT EFFLUENT,
Science and Education Administration, Lewis, TN. Dairy Experimental Station.
B. F. Hollon, J. R. Owen, and J. I. Sewell.
Journal of Environmental Quality, Vol 11, No 1, p 5-9, January-March, 1982. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Animal wastes, *Water pollution sources, Runoff, *Dairy industry, *Feedlot runoff, Feedlots, Farm wastes, Water quality, Flow rates, Surface runoff, *Path of pollutants.

A study was begun in 1975 to determine water quality in a stream both above and below the point of direct discharge of surface runoff and waste water from a 200 cow dairy feedlot operation and to evaluate changes in pollution level at selected distances downstream from the point of discharge. The dairy experiment station consists of 172 ha, with a rolling to steep topography. Soils are primarily clay and silt loams over a limestone substrate. Grab samples were collected at 2 week intervals from stations located 400 meters and 3 km upstream, and 100, 500 and 1200 meters downstream from the point source of discharge. Mean coliform concentrations exceeded the EPA permissible level of 2,000/100 ml at 100 and 500 meters below the point source of discharge, but not at 1200 meters. All other parameters were below the permissible levels, Mean concentrations increased for all parameters except BOC and pH when downstream stations were compared with upstream stations. Concentrations of fecal coliforms, fecal streptococci, BOD and orthophosphate declined significantly at 1200 meters, while other parameters were unchanged or declined slightly. Discharge of effluent into the stream did not appear to have a great effect on water quality, and the value of controlling the discharge would be questionable in terms of improving water quality in the receiving stream. (Baker-FRC)
W82-04860

THE OCCURRENCE OF FLOW CHANNELS IN SOILS,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 3C.
W82-04875

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APPLICATION OF AN APPROXIMATE ANALYTIC METHOD OF COMPUTING SOLUTE PROFILES WITH DISPERSION IN SOILS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, J. R. Williams, and J. T. Ritchie.
Journal of Environmental Quality, Vol 11, No 1, p 151-155, January-March, 1982. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Solute transport, *Model studies, *Leaching, *Fertilizers, Nitrates, Nitrogen, Mathematical studies, Lagrangian coordinates.

This paper presents an approximate analytic method of computing the effects of dispersion, assuming that the mean solute penetration depth alpha is separately determined so that alpha provides a Lagrangian coordinate system for the dispersion calculations. The method is based on theories suggested by DeSmedt and Wierenga and assumes that irregular field boundary conditions can be replaced by a defined equivalent constant-flux boundary condition. The adequacy of this assumption was tested using data on the leaching of nitrogen-15 labeled fertilizer nitrate. The use of the analytic model described gave useful interpretation of the field monolith lysimeter data on the movement of the fertilizer. The study data was collected over 3 years from four undisturbed field lysimeters, each enclosed in an 8 square meter block whose topsoil was Keene silt loam. The approximate analytic equation was developed as follows: the solution of the convection/dispersion equation for a step change in concentration under constant flux boundary conditions was assumed to apply approximately under non-steady conditions using an equivalent constant flux. Then an equation describing convection/dispersion of an initially rectangular concentration pulse was constructed by superposition. (Baker-FRC)
W82-04876

A CONTRIBUTION TO SIMPLIFIED MODELS OF FIELD SOLUTE TRANSPORT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, J. R. Williams, and J. T. Ritchie.
Journal of Environmental Quality, Vol 11, No 1, p 146-150, January-March, 1982. 1 Tab, 19 Ref.

Descriptors: *Solute transport, *Model studies, Nitrates, Nitrogen, *Agricultural chemicals, Fertilizers, Leaching, Irrigation, Irrigation programs.

This paper develops and tests the utility of a simple deterministic model for predicting the movement of the mean depth of solute penetration resulting from application of a non-sorbed and non-transformed solute, such as chloride ions. In situations where a peak is discernible in the solute concentration profile, peak position may be substituted for mean solute penetration depth. Despite transformation of the forms of nitrogen, the model is also tested against field observations on the movement of the leachable or mobile form, nitrite ions. The model appears to give results sufficiently accurate for management of mobile solutes in the field, provided tow major assumptions are satisified: that the end result if infiltration into soil is adequately described by a water budgeting approach using knowledge of the soil's field capacity, and that the solute undergoes no processes other than convection (or mass transport) together with dispersion and diffusion. Such other processes could be chemical transformation or sorption, preferential movement down fissures or voids, or instability effects. In contrast to the leaching of anions such as NO3 and Cl, cations are much more strongly sorbed in general, but then their loss by leaching is less severe. The calculations presented are based on physical theory and are of a simplicity compatible with practical irrigation management. (Baker-FRC)
W82-04877

DECOMPOSITION OF CHELATES LEACHED FROM WASTE DISPOSAL SITES,
Technion-Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Y. Avnimelech, and A. Raveh.
Journal of Environmental Quality, Vol 11, No 1, p 69-72, January-March, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Chelating agents, Chelation, Heavy metals, *Landfills, *Leachates, Sludge, Water pollution sources, Solid waste, Water quality, Drainage, Adsorption.

A simple and reliable method was developed to determine the chelating capacity of leachates and soil solution in a study of the degradation of chelating agents in soil. The method is based on the measurement of the effect of chelating agents on the solubility of calcium carbonate. The decomposition of chelating agents in soil as affected by soil composition and aeration was studied with this procedure. Leachates from most waste disposal sites are rich in organic matter and have the capacity to chelate heavy metals and carry them to different water bodies. Leachates from sanitary landfills have been found to contain up to 900 ppm of iron. Leachate coming out of a sanitary landfill model is shown to be stable under anaerobic conditions. However, if exposed to aerobic conditions the chelation capacity is reduced to 0.1-1% of its initial value within about 10 weeks. Physical adsorption of the chelating agent on clay or calcium carbonate particles does not seem significant. The clear-cut effect of aeration on the decomposition of chelating agents manifests the importance of proper and prolonged aeration of the leachate along its pathway from the waste disposal site to the receiving water body. Direct drainage, under anaerobic conditions, from a waste disposal site into a water body should be avoided. (Baker-FRC)
W82-04879

BACTERIOLOGICAL QUALITY OF SURFACE AND SUBSURFACE RUNOFF FROM MANURED SANDY CLAY LOAM SOIL,
Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2A.
W82-04880

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS AND ASSOCIATED BENTHOS IN LAKE ERIE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5A.
W82-04882

BIOSORPTION OF HYDROPHOBIC ORGANIC POLLUTANTS BY MIXED MICROBIAL POPULATIONS,
Environmental Research Lab., Athens, GA.
W. C. Steen, and S. W. Karickhoff.
Chemosphere, Vol 10, No 1, p 27-32, 1981. 3 Tab, 12 Ref.

Descriptors: *Bioaccumulation, *Bacteria, *Aromatic compounds, *Fate of pollutants, Organic compounds, Polyaromatic hydrocarbons, Phenanthrene, Pyrene, Accumulation, Solubility, Partition coefficients.

Microbial biosorption or bioaccumulation of aquatic pollutants has received increased attention because of its impact on the environmental fate and effects of hazardous organics in aquatic systems. Biosorption partition coefficients for pyrene and phenanthrene were determined on mixed microbial populations generated from 14 sediments and soils collected in several states. Sorption isotherms were determined by equilibrating aliquots of the stock bacterial suspensions with variable concentrations of aqueous solutions of pyrene or phenanthrene at 25 C. The coefficients, 24600 + 6000 for pyrene and 6340 + 1000 for phenanthrene, were nearly constant for all the microbial populations, regardless of source. Semi-empirical equations were developed to relate biosorption partition coefficients to octanol/water partition coefficients and to water solubility and melting point. It is expected that the equations obtained can be extended to other familites of hydrophobic compounds besides the condensed ring aromatics with little or no coefficient adjustment. (Cassar-FRC)
W82-04885

SULFATE WASHOUT RATIOS IN WINTER STORMS,
Battelle Pacific Northwest Labs., Richland, WA.
B. C. Scott.
Journal of Applied Meteorology, Vol 20, No 6, p 619-625, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Sulfates, *Storm runoff, Precipitation, Rainfall, Water pollution sources, *Path of pollutants, Winter storms.

This paper examines washout ratio variability for sulfate deposition during the winter season. The variability of the data is clearly evident and is plotted so as to illustrate the vast range of washout ratios observed. However, specific trends do emerge, such as an apparent relationship between the washout ratio and the precipitation rate. The microphysical processes of precipitation growth exerted a definite influence on the washout ratio. Indeed, by stratifying the data according to dominant mode of precipitation growth, some insight was gained into the complexities of nucleation scavenging and transformation processes. Evidence based on the total number of observations in 15 storms suggested that the number of events which contain rimed snow are about equal to the events which contain unrimed snow. Since the nature of precipitation growth can influence sulfate deposition rated by a factor of 50 or more, it is significant to distinguish between these two dominant growth modes, riming versus vapor deposition. More important is the implication that in spite of a rather detailed theoretical explanation of wet removal, washout ratios for sulfate cannot be reliably predicted to within a fator of 2. Thus, much work clearly remains in identifying and parameterizing sulfate removal mechanisms and rates during storm periods. (Baker-FRC)
W82-04898

BIODEGRADATION OF HAZARDOUS ORGANIC POLLUTANTS,
Illinois Inst. of Tech., Chicago.
J. W. Patterson, and P. S. Kodukala.
Chemical Engineering Progress, Vol 77, No 4, p 48-55, April, 1981. 5 Tab, 15 Ref.

Descriptors: *Biodegradation, *Organic compounds, *Industrial wastewater, Priority pollutants, *Wastewater treatment, Biological treatment, Degradation, *Fate of pollutants, Ozonation, Activated carbon, Adsorption, Bioaccumulation, Accumulation.

Less than half of the 114 known organic priority pollutants occur in industrial effluents with sufficient frequency to warrant broad-scale controls. Those with the highest frequency are phthalates, chloroform, methylene chloride, benzene, toluene, phenol, ethylbenzene, naphthalene, phenanthrene/anthracene, tetrachloroethylene, trichloroethylene, and trichloroethane. Several treatment systems for hazardous organics are available. Air and steam stripping, dependent on the principles of Henry's Law, produce air pollution and contaminated condensates, respectively. Ozone oxidation, activated carbon adsorption, and biological degradation are each effective in destroying some of the compounds on the list. In some cases more toxic compounds are formed in the process. A table lists the degree of removal of many toxic organic compounds by biological treatment systems. Several compounds concentrate in sludge by factors of 5 to 100. These are acenaphthene, 1,2- and 1,3-dichlorobenzene, fluoranthene, naphthalene, N-nitrosodi-n-propylamine, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl and di-n-octyl phthalates, dimethyl phthalate, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, acenaphthylene, fluorene, phenanthrene, pyrene, tetrachloroethylene, and toluene. (Cassar-FRC)
W82-04910

GEOTHERMAL POWER: ACCIDENTAL FLUID RELEASES AND WASTE DISPOSAL,

California Univ., Livermore. Lawrence Livermore Lab.
D. W. Layton, and W. F. Morris.
Chemical Engineering Progress, Vol 77, No 4, p 62-67, April, 1981. 4 Fig, 28 Ref.

Descriptors: *Geothermal power, *Cooling water, *Waste disposal, Water pollution control, *Water pollution sources, *Underground waste disposal, Saline water, Hydrogen sulfide, Boron, Ammonia, Powerplants, Injection wells, Wastewater treatment.

Geothermal power plants are a potential source of environmental contamination through accidental releases of saline geothermal fluids and the disposal of liquid and solid wastes. The composition of geothermal fluids varies according to site, up to 250,000 mg per liter total dissolved solids at Salton Sea, California, and may contain boron, arsenic, lead, hydrogen sulfide, and other toxic substances. A spill of 1300 cu m could contaminate soil water and surface waters. Berms can protect against such accidental releases. The most feasible disposal technique for spent geothermal fluids, the most abundant waste, is injection into underground wells. The solid wastes require disposal in carefully constructed and monitored landfills. The ammonium sulfate recovered from the hydrogen sulfide removal process may be marketed as fertilizer if it is boron-free. Cooling waters for geothermal facilities are obtained from irrigation water, waste agricultural water, and steam condensate from flashed-steam power plants. Treatment to remove the substantial suspended solids and dissolved solids of these cooling waters produces significant quantities of solids. An alternate to evaporation ponds is subsurface injection into an aquifer isolated from potable water supplies. Cooling tower drift is a source of boron which can damage agricultural crops and enter the soil. Boron emissions at a 106 MW facility are estimated at 2273 kg per year. Design of geothermal power facilities must provide for accidental releases of fluid, treatment of spent fluids, proper disposal of toxic wastes and blowdown, and containment of drift. (Cassar-FRC)
W82-04911

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: I. SUNLIGHT INDUCED REACTIONS OF AQUATIC POLLUTANTS PHOTOSENSITIZED,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-04914

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: II. PHOTOSENSITIZED OXYGENATIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-04915

THE OCCURRENCE AND ORIGIN OF METHANE IN SOME GROUNDWATER FLOW SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2K.
W82-04925

UPTAKE OF ARSENIC, CADMIUM, LEAD AND MERCURY FROM POLLUTED WATERS BY THE WATER HYACINTH EICHORNIA CRASSIPES,
Jackson State Univ., MS. Dept. of Chemistry.
F. E. Chigbo, R. W. Smith, and F. L. Shore.
Environmental Pollution, Series A, Vol 27, No 1, p 31-36, January, 1982.. 2 Tab, 18 Ref.

Descriptors: *Monitoring, *Water quality, Cadmium, Lead, Mercury, Arsenic, *Heavy metals, Water pollution control, Plants, *Water hyacinth, *Adsorption.

The ability of the water hyacinth to simultaneously accumulate arsenic, cadmium, lead, and mercury at a relatively high level of exposure was investigated. After cultivation of the plants for 2 days in tanks containing 10 ppm of each of the metals in aqueous solution, the plants were harvested and rinsed with tap water. The leaves and stems were separated and analyzed for each of the metals. The ratio of the concentrations of arsenic and mercury in the leaves to the concentrations in the stems was about 2:1. Cadmium and lead showed a concentration ratio in leaves to stems of about 1:1. Leaf concentration of arsenic was the lowest of the metals at 0.3428 mg/g of dried plant material while the leaf concentration of cadmium was highest at 0.5740 mg/g of dried plant material. Analyses were also made of control plants grown in unpolluted water and of plants grown in Bay St. Louis, Mississippi sewage lagoon. The mercury concentrations of plants grown in the sewage lagoon were significantly different from the control sample, which had a concentration of 0.0700 mg/g of dried plant material. These findings suggest that the water hyacinth can absorb relatively high concentrations of arsenic, cadmium, mercury and lead over a relatively short period of time. Periodic analysis of wild plants should result in a pollution monitor of the water to which the plants are exposed. (Baker-FRC)
W82-04936

THE NEW POLLUTION--GROUNDWATER CONTAMINATION,
For primary bibliographic entry see Field 5C.
W82-04938

ORGANIC MATTER TRANSPORT IN AN APPALACHIAN MOUNTAIN RIVER IN VIRGINIA, U.S.A.,
Virginia Polytechnic Inst., and State Univ., Blacksburg. Dept. of Biology.
L. A. Newbern, J. R. Webster, E. F. Benfield, and J. H. Kennedy.
Hydrobiologia, Vol 83, No 1, p 73-83, 1981. 5 Fig, 3 Tab, 42 Ref.

Descriptors: *Rivers, *Organic matter, Decomposing organic matter, Detritus, Litter, Municipal wastes, Industrial wastes, *New River, Virginia, *Path of pollutants.

Results are presented of an investigation of organic matter transport in an Appalachian Mountain river. The New River is a sixth order stream flowing partly in the ancient Teas River channel in the Appalachian Mountains and is considered to be the second oldest river in the world. Collections for study were made at two points:near Fries, Virginia, and near Glen Lyn, Virginia. Between these two points were several cities and industries which release effluent into the river. Dissolved organic matter was the most abundant form of organic matter transported at both sites throughout most of the year. For the most part, dissolved organic matter concentrations were similar to values reported or other medium to large rivers. Highest dissolved organic matter values were recorded during low flows, but there was no statistically significant correlation between the concentration and discharge. Fine particulate organic matter concentrations were in general lowest in the winter, somewhat higher in summer, and exhibited sharp peaks in spring and fall. No statistically significant correlations between fine particulate organic matter and river discharge over the year or seasonally were detected. However, fine particulate organic matter concentrations increased 15-fold during a storm. Coarse particulate organic matter concentration was highest during autumnal leaf fall and constituted about 13% of the total particulate organic matter samples. However, coarse particulate organic matter was generally less than 1% of the total particulate organic matter throughout most of the year. It appeared that municipal and industrial treatment facilities between the two study sites supplemented the concentration of dissolved organic matter in the river. (Baker-FRC)
W82-04949

BEHAVIOR OF ORGANIC PRIORITY POLLUTANTS IN THE TERRESTRIAL SYSTEM: DI-N-BUTYL PHTHALATE ESTER, TOLUENE, AND 2,4 DINITROPHENOL,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
M. R. Overcash, J. B. Weber, and M. L. Miles.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224544, Price codes: A06 in paper copy, A01 in microfiche. Report No 171, January, 1982. 94 p, 22 Fig, 24 Tab, 173 Ref. OWRT B-122-NC(6). 14-34-0001-9088.

Descriptors: *Path of pollutants, Pollution effects, Plant growth, Plant toxicity, *Organic compounds, Phytotoxicity, Fate of pollutants, Plant growth, *Water pollution effects, Organic priority pollutants, Di-n-butyl phthalate (DnBP) ester, Toluene, 2-4 Dinitrbphenol.

Detailed literature reviews were performed for three of the organic priority pollutants. These reviews were strictly oriented toward the terrestrial system response, including soil adsorption, microbial decomposition, abiotic losses, plant phytotoxicity and uptake by vegetative species. Data and conclusions from these evaluations can be used directly in land treatment design, in-situ spill cleanup design, and multi-media effects studies on terrestrial systems. Specific soil decomposition experiments were conducted for di-n-butyl phthalate (DnBP) and 2,4 dinitrophenol (DNP). The half life of DnBP when applied at 1,000 - 10,000 ppm (dry soil basis) was in excess of 26 weeks while at 200 ppm t 1/2 is about 12 weeks (the latter is closer to actual land treatment loading rates). For DNP the half life was less than 4 weeks for soil loadings of 5-50 ppm (dry soil basis). Volatilization and abiotic loss rates for DnBP and DNP were also determined. DnBP had less than 5% loss by these mechanisms while DNP losses were greater than 90%. Phytotoxicity studies were conducted on corn, soybean and fescue seeds freshly planted in the chemical-soil mixture. For toluene a significant germination effect was determined at 2000 ppm for corn and soybeans. DNBP affected soybean germination at 200 ppm but not corn (even at 20,000 pm). DNP was the most phytotoxic with germination effects appearing at 80 ppm for corn and 40 ppm for soybean.
W82-04965

ALGAL-AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS FROM LOWER GREAT LAKES TRIBUTARIES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of Great Lakes Research, Vol 7, No 3, p 311-325, 1981. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Phosphorus, *Sediments, *Algae, Lakes, Rivers, *Great Lakes tributaries, Suspended sediments, Phytoplankton, Selenastrum, Particulate matter, Model studies, Fate of pollutants, Maumee River, Sandusky River, Cuyahoga River, Ohio, Cattaraugus River, Genesee River, New York.

Phosphorus available for algal growth was measured in suspended sediment from 5 tributaries to the lower Great Lakes during March-June 1980. The rivers were Maumee, Sandusky, and Cuyahoga in Ohio and Cattaraugus and Genesee in New York. Both chemical analyses and bioassays under aerobic conditions were performed. An average of 21.8% of total particulate P was ultimately available to Selenastrum capricornutum. Total sediment P (in micrograms P per mg dry weight) and ultimately bioavailable P were higher in the Ohio rivers, mean 1.06-1.25 and 6.1-19.5% of total, respectively. Non-apatite fractions of inorganic P (base- and reductant-extractable) correlated well with levels of available P in the suspended sediment samples. The rate of available P release from the sediments was generally independent of the observed sediment characteristics. Accuracy of model studies on P dynamics may be improved by considering available P to be released from an ultimately available fraction of the total particulate P in the water column rather than the short-term available P. (Cassar-FRC)
W82-04994

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CIRCULAR WALL JETS IN COFLOWING STREAMS,
Alberta Univ., Edmonton.
N. Rajaratnam, and M. J. Stalker.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 187-198, February, 1982. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Path off pollutants, *Open channels, *Jets, *Flow velocity, *Mixing, *Mathematical studies, *Flow profiles, Fate of pollutants, Flow discharge, Channel flow, Nozzles, Instream flow, Industrial wastewater.

The diffusion of circular turbulent wall jets for the discharge of industrial or municipal wastewaters into a coflowing stream was studied, with the depth of flow in the range of 20-30 times the nozzle diameter and the jet velocity varying from about 2 to 30 times the mean velocity of the channel flow. Similar distributions were found between the jet longitudinal velocity and the stream velocity in the free mixing region in the channel centerplane. The velocity profiles might be described by a power law that varies the exponent within a band in the boundary layer portion. The jet velocity with respect to the free stream was found to be similar in the transverse direction in the horizontal plane of the maximum velocity. The length scales in the vertical direction and in the transverse direction were correlated using the excess momentum thickness. The velocity and shear velocity scales have also been correlated using the excess momentum thickness. When the ration of the longitudinal distance from the nozzle to the excess momentum thickness is near 5, the present results give good agreement with the corresponding predictions for circular free jets in coflowing streams. For larger values of this ratio, the results are influenced by the presence of the boundary (bed). The freestream gives significant restrictions of the transverse spreading of the jet compared with circular wall jets in stagnant ambients. (Geiger-FRC)
W82-04999

THERMAL FRONT FORMATION FROM BUOYANT SURFACE JETS,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 5C.
W82-05004

MIGRATION OF RUTHENIUM-106 IN A NEVADA TEST SITE AQUIFER: DISCREPANCY BETWEEN FIELD AND LABORATORY RESULTS,
Lawrence Livermore National Lab., CA.
D. G. Coles, and L. D. Ramspott.
Science, Vol 215, No 4537, p 1235-1237, March, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Radioactive wastes, *Groundwater, Wells, Migration, Aquifers, Groundwater movement, Water pollution sources, Nuclear explosions, Ruthenium-106, *Nevada Test Site.

As part of a program to study the interaction of nuclear explosion debris and ground water, events in a flooded nuclear waste repository were also considered. The migration rate of ruthenium-106 in the field was investigated. Water was sampled from a well which intersected the explosion cavity created by detonating a nuclear device at a depth of 294 meters in tuffaceous alluvium. Tritium and strontium-90 were the only radionuclides whose concentrations were above the maximum permitted for unrestricted public use of drinking water, even though the water had been in direct contact with nuclear debris for 10 years. A satellite well was drilled 91 meters south of the explosion point to study migration rates of the radionuclides in the cavity water. Pumping from the satellite well induced a gradient between the explosion point and the well. Ruthenium-106 migrated in ground water at about the same velocity as tritium from the underground explosion site to the pumped satellite. This finding contradicts the predictions of laboratory studies based on batch sorption measurements that ruthenium-106 should migrate at a much lower rate than tritium. To predict migration of radionuclides in groundwater, more relevant laboratory measurements are needed. (Baker-FRC)
W82-05008

GC/MS ANALYSIS OF XAD-2 EXTRACTS OF SUPERCHLORINATED SEPTAGE,
North Texas State Univ., Denton. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-05016

UPWARD TREND IN NITRATE CONCENTRATIONS IN RIVER DISCHARGING INTO LOUGH NEAGH FOR THE PERIOD 1969-1979,
Ministry of Agriculture, Belfast (Northern Ireland). Agricultural and Food Chemistry Div.
R. V. Smith, R. J. Stevens, R. H. Foy, and C. E. Gibson.
Water Research, Vol 16, No 2, p 183-188, February, 1982. 5 Fig. 5 Tab, 15 Ref.

Descriptors: *Nitrates, *Rivers, Water quality, Public health, Drinking water, Phytoplankton, Municipal wastewater, Land use, Farming, *Water pollution sources, *Lough Neagh, *Northern Ireland.

Results are reported of a discrete sampling program of the nitrate concentrations in the major rivers discharging into Lough Neagh for the period 1969-1979. An attempt was made to assess causal factors for the increase in nitrate concentration observed by examining the trends in land usage, drainage, agricultural practices and human population over the study period. The Lough Neagh catchment has a total size of 4453.4 square kilometers, with average rainfall of 1028 mm. Six inflow rivers drain 88% of the catchment. Soil material is mostly basaltic glacial till, and the principal soil associations are climatic peat and acid brown earths and gleys on the lowland. The mean nitrate N concentration in the major rivers discharging into Lough Neagh for the years 1969 and 1970 was 1.41 mg nitrogen/liter. For the years 1978-1979 this mean had risen to 2.41 mg nitrogen/liter. One important concern regarding this increased nitrate concentration was the possible increased risk of methemoglobinemia if these waters were consumed directly by infants. However, all present values are well below the permissible nitrate concentration of 11.3 mg nitrogen/liter. A notable feature regarding changes in land use in Northern Ireland during the study period is the reduction in arable farming, which is a continuation of a trend established since World War II. Another factor is the human population changes during the study period. A redistribution occurred between the rural and sewered population. Rural populations declived from 144,000 to 128,000, while the sewered population increased by 25%. Still it seems unlikely that the increase in human sewered population observed could have contributed more than 3.7% increase to the rise in nitrate concentration noted in the present study. (Baker-FRC)
W82-05017

A BUDGET MODEL ACCOUNTING FOR THE POSITIONAL AVAILABILITY OF PHOSPHORUS IN LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra.
Water Research, Vol 16, No 2, p 205-209, February, 1982. 3 Fig. 1 Tab, 23 Ref.

Descriptors: *Lakes, *Phosphorus, Eutrophication, *Model studies, Sediments, Lake Erie, Phosphorus loading, Lake sediments, Suspended sediments.

A budget model for phosphorus loading relationships in lakes is presented. The model takes into consideration the fact that phosphorus may be reintroduced into the water column by wind-induced sediment resuspension in shallow lakes. The model is calibrated with Schaffner and Oglesby's data from lake loading/response relationship studies and is used to simulate in-lake phosphorus levels for the three basins of Lake Erie. The major objective of the model development was to provide a more mechanistic framework for assessing the effect of positional availability on lake eutrophication. An ancillary result was the reintroduction of mean depth as an explicit variable in trophic state assessment. The model as presented accounts for both the rapid settling of allochthonous particles and the slow settling of autochthonous particles that remove phosphorus from the water column. The effect of resuspension of bottom sediments is modeled by making the apparent settling velocity a function of lake depth. The resuspension effect is important for lakes less than 10 meters in depth. (Baker-FRC)
W82-05018

DETECTION OF DIETHYLNITROSAMINE IN NITRITE-RICH WATER FOLLOWING TREATMENT WITH RHODAMINE FLOW TRACERS,
National Fishery Research Lab., La Crosse, WI.
S. L. Abidi.
Water Research, Vol 16, No 2, p 199-204, February, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Dyes, *Nitrites, Nitrosamines, Carcinogens, *Tracers, Dye releases, Public health, Environmental effects, Rhodamine B, Rhodamine WT, Diethylnitrosamine, *Path of pollutants.

The results of an investigation of the reaction of nitrite with two commonly used water tracing dyes are reported. The effects of reaction variables on yields of diethylnitrosamine (DENA), including inhibition by ascorbic acid, are described. The optimum pH for quantitative formation of DENA is 5. On either side of 5 the yields decreased. The more favorable nitrosation occurred at a higher level of nitrite relative to the starting amine, at a more elevated temperature, and at a longer duration of reaction. A yield as high as 75% was realized when the reaction was run with a large excess of nitrite in pH 5 buffer at 80 degrees C for 12 hr. Under identical conditions, the DENA yield from Rhodamine WT was at least twice that obtained from Rhodamine B. It is suggested that the additional carboxy group in the former accelerated its conversion into the nitrosamine. Ascorbic acid effectively inhibited nitrosation. Experiments were also made on environmental samples. Samples were collected and pH's and nitrite-nitrate contents measured. Samples were taken and treated with Rhodamine flow tracer at levels of 1, 10 and 20 micrograms/liter. Mixtures were stirred gently with and without added nitrite. The dichloromethane extracts of each of the nitrosated mixtures were then purified and analyzed for DENA. The levels of nitrite present in local stream water were thus monitored weekly by sampling top and bottom river water . Photodegradation of DENA formed in river water samples containing the Rhodamine dye and nitrite proceeded somewhat sluggishly. The finding that red fluorescent water tracing dyes can react with nitrite in natural water to form the carcinogenic DENA is cause for concern. (Baker-FRC)
W82-05022

INDIA: EVERY RIVER POLLUTED, AND FEW EFFECTIVE CONTROLS,
D. J. Davidar.
Ambio, Vol 11, No 1, p 63-64, 1982.

Descriptors: *Water pollution control, *Legal aspects, *Water pollution sources, *India, Water pollution, Drinking water, Municipal wastes, Industrial wastes.

Every major river system in India is polluted. Although the major part of the pollution is caused by biodegradable domestic wastes, heavy metals such as mercury, cadmium, nickel, manganese, lead, chromium, copper and antimony have been found in rivers in Gujarat, Rajasthan, Bihar, Maharashtra, Kerala and Andhra Pradesh. All the rivers have industrial pollutants discharged into them by industries. Toxic wastes are indiscriminately dumped on land as well. What aggravates the problem of land and water pollution is the seasonal monsoon rains. When the rains fall the stockpiled wastes are leached into thee groundwater reservoirs which are used for drinking pur-

poses. Any wastes dumped into the smaller rivers become highly concentrated when the rivers dry up. Sanitary conditions in the entire country are minimal. Only 8 of the more than 3000 cities in India have complete sewage facilities, leading to enormous problems. Nuclear and radioactive wastes must also be disposed of in this country. National and state legislation to regulate all the various types of pollution does exist. Under provisions of the Water Pollution Act most State Boards have functions including laying down safe pollution levels for industry, monitoring air and water quality, and prosecuting violators of pollution controls. But the State Pollution Control Boards have not been very effective. When prosecuted, private companies sometimes threaten to close down the factory rather than install pollution control measures. Lack of funds and trained personnel make the job harder. (Baker-FRC)
W82-05033

WEAK CONTROLS FROM SEA TO SHINING SEA,
University of Western Ontario, London. Dept. of Zoology.
D. M. Ogilvie.
Ambio, Vol 11, No 1, p 51-53, 1982. 2 Fig, 7 Ref.

Descriptors: *Hazardous materials, *Waste disposal, Water pollution sources, Groundwater pollution, *Canada, *Legal aspects, *Regulations, Leaching.

A rather low standard of care has been maintained in Canada concerning hazardous wastes, and the results are clearly evident in many parts of the country where improper waste disposal practices have been carried on. The discharge of benzene-containing solvents and mercury-contaminated acids into the sewer system, the presence of mercaptan pesticide in an insecure landfill, the dumping of wastes contaminated with heavy metals and cyanide in municipal dumps, and the contamination of groundwater by leaky dumpsites have been reported. Industry spokesmen claim it is difficult and expensive for many companies to do anything with their wastes except dump them into the sewer system. In the wheat producing province of Saskatchewan an aquifer that supplies drinking water for the capital city of Regina is reported in danger of contamination from a 1976 PCB spill and from chemicals leaching from a landfill site. One proposal to alleviate the situation calls for management of hazardous wastes in western and northern Canada to be done on a regional, rather than strictly provincial, basis. The system would consist of one incineration plant to serve the entire region, with physical-chemical treatment plants in each of the four western provinces and a network of collection stations across the region. Federal control can be applied to environmental hazards which are associated with activities such as fishing and with certain aspects of manufacturing and shipping. Provincial governments have broad legal jurisdiction. However, it is mainly with provincial authority that waste disposal can be controlled. The Canadian legal system has few absolute constraints on government actions to effectively control and regulate hazardous substances. The key question is whether governments will adopt appropriate regulatory policy. (Baker-FRC)
W82-05035

INFILTRATION INFLOW ANALYSIS: FINDING THE SOURCE,
CH2M/Hill, Seattle, WA.
K. T. Holmes, E. Black, and D. E. Brown.
American City and County, Vol 97, No 2, p 23-26, February, 1982.

Descriptors: *Sewer systems, *Infiltration, *Sewer infiltration, *Testing procedures, Stormwater, Runoff, Wastewater collection, *Springfield, *Oregon.

As a first step in the sewer system evaluation survey for Springfield, Oregon, flows in the wastewater collection system were monitored at 54 manhole sites during low and high groundwater conditions. This monitoring revealed that groundwater entered the 165 mile collection system when the water table was above the pipeline invert. It also showed that rainfall caused an immediate and sharp increase in flows. To complete the study, the wastewater collection system was smoke tested to locate sources of storm induced infiltration and direct stormwater runoff entry. From the outset it was recognized that smoke testing is only a detecting technique and cannot be used to quantify the I/I flow rate. It was also noted that smoke testing would not reveal what needed to be repaired in a sewer section without additional field work. Testing also would not reveal the location of a defect between manholes. Also, if smoke is not observed escaping, it does not necessarily mean the manhole-to-manhole segment tested does not have any defects. Dyed water testing was conducted at each of the 79 indicated cross connection locations to determine the exact location of any connection. Use of the dyed water testing with closed-circuit internal television inspection revealed that most of the noted sites were not directly connected. (Baker-FRC)
W82-05038

MOVEMENT AND IDENTIFICATION OF A CREOSOTE-DERIVED PAH COMPLEX BELOW A RIVER POLLUTION POINT SOURCE,
Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black.
Archives of Environmental Contamination and Toxicology, Vol 11, No 2, p 161-166, 1982. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Creosote, *Sediments, *Rivers, Water pollution sources, Fate of pollutants, Path of pollutants, Polyaromatic hydrocarbons, Aromatic compounds, *Hersey River, *Michigan, Muskegon River, Organic compounds, Hydrocarbons, Wood treatment wastes.

A wood treatment operation abandoned in 1949 was identified as the source of creosote contamination of the Hersey River, Michigan. Creosote from two major spills of 15,000 and 18,000 gal as well as small leaks and drips had permeated the sandy surface soils to an impervious clay layer, then entered the river via springs. Sampling of river sediments at 9 sites and analysis by high pressure liquid chromatography showed a pattern of pollution concentration that decreased in a double exponential curve with distance. The greatest concentrations of polyaromatic hydrocarbons and of the individual compounds monitored (1,2-benzanthracene and 3,4-benzo(a)pyrene) were found directly downstream from the source. Levels were 231,000, 61,669, and 15,817 ng per g (wet basis), respectively. These levels decreased to 352, 1023, and 396 ng per g wet basis, respectively, at 400 decameters from the source. The curve obtained by plotting distance from the source against concentration of contaminants was asymptotic, implying that the river's sediments were polluted over a considerable distance. (Cassar-FRC)
W82-05042

PROCEDURES FOR THE COLLECTION OF REPRESENTATIVE WATER QUALITY DATA FROM MONITORING WELLS,
Illinois State Water Survey Div., Campaign; and Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W82-05051

PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC,
Louisville Gas and Electric Co., KY.
For primary bibliographic entry see Field 5E.
W82-05066

EXECUTIVE SUMMARY FOR POWER PLANT COOLING SYSTEM WATER CONSUMPTION AND NONWATER IMPACT REPORTS.
United Engineers and Constructors, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 2D.
W82-05067

MODELING OF LEACHATE ORGANIC MIGRATION AND ATTENUATION IN GROUNDWATERS BELOW SANITARY LANDFILLS,
Waterloo Univ., Ontario.
J. F. Sykes, S. Soyupak, and G. J. Farquhar.
Water Resources Research, Vol 18, No 1, p 135-145, February, 1982. 11 Fig, 3 Tab, 33 Ref.

Descriptors: *Leachates, *Landfills, *Organic matter, *Model studies, Sanitary landfills, Chemical oxygen demand, Path of pollutants, Fate of pollutants, Biodegradation, Degradation, Microbial degradation, Garbage dumps, Groundwater pollution.

A model for transport of organic matter, measured as COD, in soils near sanitary landfills is developed. The model treats organic transport in 3 phases. The first models degradation with simultaneous Michaelis-Menten substrate utilization and microbial mass production equations with convection and dispersion included for the former. In the biologically-active zone, suggested by these equations, substantial organic degradation occurs within small distances, often less than 5 meters, even under widely varying conditions. The second phase involves first-order decay. The third phase consists of a nonbiodegradable organic residue which migrates by connection and dispersion. Field studies were conducted at the Canadian Forces Base Borden sanitary landfill, closed in 1976, to provide data for comparison with model predictions. This showed that COD was reduced to about 100 mg per liter after traveling 1 or 2 meters, by biodegradation, not adsorption. A nonbiodegradable component of 50-100 mg per liter concentration was also detected. (Cassar-FRC)
W82-05075

NUMERICAL SIMULATION OF THE TRANSPORT AND SPECIATION OF NONCONSERVATIVE CHEMICAL REACTANTS IN RIVERS,
Commonwealth Scientific and Industrial Research Organization, Ryde (Australia). Inst. of Earth Resources.
B. M. Chapman.
Water Resources Research, Vol 18, No 1, p 155-167, February, 1982. 11 Fig, 5 Tab, 37 Ref.

Descriptors: *Solute transport, *Chemical reactions, *Rivers, *Fate of pollutants, *Model studies, Sedimentation, Chemical precipitation, Suspended solids, Absorption, Ion transport, Speciation, Mine wastes.

A model using the program MINEQL was used to simulate the transport of nonconservative chemical pollutants in flowing water. The processes of precipitation, sedimentation, and adsorption were added to a model of conservative chemical transport. The physical transport submodel used a convolution integral procedure with an approximation form of the impulse function to solve a one-dimensional convective-diffusion equation. Although the model assumed chemical equilibrium, a pseudokinetic treatment was necessary to deal with redissolution of precipitates and dissociation of surface species. Hypothetical examples were given for calcium chloride entering a stream. The model was tested by injecting NaOH into Daylight Creek, New South Wales, Australia, draining an abandoned lead-zinc mine. Concentrations of the metals Zn, Al, Cu, Fe, and Na in the stream water were expressed as total metals and as suspended solids. These were followed as a function of time and distance downstream. Significant sedimentation of the precipitate was noted. Substantial quantities of protons and/or metal ions were absorbed on the stream bed. The model results agreed reasonably with observations. Better results would have been obtained if sedimentation time constants for the five metal precipitates had been individually considered. (Cassar-FRC)
W82-05079

MERCURY CIRCULATION IN AQUATIC ENVIRONMENT. PART 3. MERCURY TRANSFORMATIONS IN SEDIMENTS,
J. Stary, B. Havlik, K. Kratzer, J. Prasilova, and J. Hanusova.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 29-33, 1980. 1 Tab, 10 Ref.

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Descriptors: *Mercury, *Methylmercury, *Sediments, Fate of pollutants, Heavy metals, Metals, Aquatic environment, Chemical reactions, *Czechoslovakia, Reslava Creek, Botic Creek.

Sediment from the Reslava Creek, Czechoslovakia, highly polluted with pulp and chemical wastes, contained an average of 0.19 + or - 0.02 ppm methylmercury (1.05% of total mercury). Sediment from the Botic Creek, polluted with urban sewage, had lower levels of methylmercury, 0.029 0.003 ppm (6.3% of total mercury). Transformation of inorganic Hg, methylmercury, and phenylmercury were studied in the laboratory using Hg203 compounds and sediments incubated by three procedures: (A) in open glass vessels for 28 days, (B) under a nitrogen atmosphere for 28 days, and (C) in test tubes standing in darkness for 42 days. Method (C), most like natural conditions, formed methylmercury at the fastest rates. The equilibrium concentration of methylmercury was dependent on the rates of the two reactions: methylation of inorganic Hg and transformation of organomercury compounds into inorganic Hg. The lower the rate of demethylation, the higher the concentration of methylmercury. During the 14-28 days necessary to reach equilibrium conditions inorganic Hg formed 1.0 to 3.9% organic Hg, methylmercury was reduced to 42-86% of the original content, and phenylmercury was reduced to 35-43% of the original content. (Cassar-FRC)
W82-05094

DOWNCORE VARIATION IN SEDIMENT ORGANIC NITROGEN,
Case Western Reserve Univ., Cleveland, OH, Dept. of Geological Sciences
For primary bibliographic entry see Field 2H.
W82-05124

FLUXES OF POLYCYCLIC AROMATIC HYDROCARBONS TO MARINE AND LACUSTRINE SEDIMENTS IN THE NORTHEASTERN UNITED STATES,
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
P. M. Gschwend, and R. A. Hites.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2359-2367, 1981. 2 Fig, 3 Tab, 50 Ref.

Descriptors: *Hydrocarbons, *Bottom sediments, Marine sediments, Lake sediments, Precipitation, Fluctuations, Aromatic compounds, *Path of pollutants, Cores.

In an effort to quantify the deposition rates for polycyclic aromatic hydrocarbons (PAH) in both remote and urban locales, the PAH abundances in several dated sediment cores from the northeastern United States were determined and the corresponding PAH fluxes to these sites were calculated. Fluxes of 10 of these hydrocarbons were measured for each of six sites for the periods roughly corresponding to the present, 1950, and 1900. Present-day deliveries of individual PAH were consistently close to 1 nanogram per square centimeter per year at remote sites, probably reflecting the atmospheric fallout of these combustion-derived pollutants. The current inputs of individual PAH at sites located nearer to urban centers averaged about 35 nanograms per square centimeter per year, presumably as a result of greater fallout of PAH-laden particles nearer their origins and of runoff delivery of PAH-contaminated sediments. The differences in the relative abundances of individual PAH support assumptions of different delivery mechanisms at urban and at remote locations. Deposition data indicate that current PAH fluxes are 5 to 10 times greater than those of 80 years ago, but that these inputs have diminished by a factor of 2 during the last two decades. (Carroll-FRC)
W82-05138

EXTRACTABLE ORGANIC MATTER IN MUNICIPAL WASTEWATERS. I. PETROLEUM HYDROCARBONS: TEMPORAL VARIATIONS AND MASS EMISSION RATES TO THE OCEAN,
California Univ., Los Angeles. Dept. of Earth and Space Sciences.
R. P. Eganhouse, and I. R. Kaplan.
Environmental Science and Technology, Vol 16, No 3, p 180-186, March, 1982. 3 Fig, 5 Tab, 33 Ref.

Descriptors: *Municipal wastewater, *Ocean dumping, *Hydrocarbons, Chemical analysis, Petroleum, Organic compounds, Organic matter, *California Bight, Fate of pollutants.

The research presented here is part of a large study aimed at characterizing the terrestrial sources of organic matter to the southern California Bight and constructing a reasonable budget for this coastal system. The majority of southern California's municipal wastewaters receive only primary treatment and are introduced directly to the ocean via submarine outfall systems at a water depth of about 60 meters. During 1979 a series of flow proportioned 24 hr composite samples were collected by personnel at each of four treatment plants. Samples were analyzed for total, aliphatic, and aromatic hydrocarbons. Mean total hydrocarbon contents of those effluents having received mainly primary treatment ranged from 6.1 to 16.3 mg/L, whereas sludge concentrations were about 340 mg/L. The vast majority of these hydrocarbons are associated with particulate matter. However, their composition was virtually identical for all effluents. The temporal variations of wastewater total hydrocarbon concentrations appeared to be independent of sampling frequency. From this data Southern California's treatment plants were estimated to discharge more than 17400 metric tons of hydrocarbons per year or 4.9 grams per capita day to coastal waters. This is about double the input rate due to surface runoff in this same region. It also represents nearly 6% of the worldwide input of wastewater borne petroleum to the ocean. Problems associated with global input assessments are considered, and a correlative means of estimating wastewater hydrocarbon concentrations is presented. (Baker-FRC)
W82-05142

EMPIRICAL TEST OF THE ASSOCIATION BETWEEN GROSS CONTAMINATION OF WELLS WITH TOXIC SUBSTANCES AND SURROUNDING LAND USE,
Rutgers-The State Univ., New Brunswick, NJ.
M. Greenberg, R. Anderson, J. Keene, A. Kennedy, and G. W. Page.
Environmental Science and Technology, Vol 16, No 1, p 14-19, January, 1982. 7 Tab, 11 Ref.

Descriptors: *Well water, *Groundwater pollution, *Land use, *Pesticides, Chlorinated hydrocarbons, *Heavy metals, Water pollution sources, *New Jersey.

In order to get a broad perspective on the spatial distribution of hazardous substances in the environment, it is necessary to explore the relationship between land use and gross contamination by hazardous materials. Data on toxic substances present in water from a sample of 408 wells located throughout the state of New Jersey were used to select the following: the 10 wells most contaminated with light chlorinated hydrocarbons, the 10 wells with the highest levels of pesticides, the 10 wells with the highest levels of heavy metals, and a control group of 10 wells with nondetectable or trace amounts of the 45 toxic pollutants investigated. New Jersey's Land Oriented Reference Data System (LORDS), which provides 21 categories of land use based on aerial photography, was used to identify land uses within a 1 mile radius and within a 10 mile radius of each of the 40 wells selected. Factor analysis showed that the 45 chemicals investigated strongly associated by type and that each of the wells tended to associate with only one of the categories. The Mann-Whitney test and discriminant analysis were used to determine whether any of the four groundwater well groups had significantly different percentages of any of the 21 land uses. Distinctive land-use patterns were found for the 1-mile radius areas surrounding the pesticide and light chlorinated hydrocarbons wells, while the heavy metal and clean well land use profiles were similar to each other. The pesticide wells showed a relative excess of mixed and evergreen forests and agricultural land uses within 1 mile of the well sites, while residential, industrial, utility, commercial, and other urban land uses were dominant in the areas within a 1 mile radius of wells highly contaminated with light chlorinated hydrocarbons. (Carroll-FRC)
W82-05143

EXPERIMENTAL STUDIES TO DETERMINE THE FATE OF PETROLEUM HYDROCARBONS FROM REFINERY EFFLUENT ON AN ESTUARINE SYSTEM,
Bermuda Biological Station, St. Georges West.
A. H. Knap, and P. J. LeB. Williams.
Environmental Science and Technology, Vol 16, No 1, p 1-4, January, 1982. 5 Tab, 24 Ref.

Descriptors: *Industrial wastes, *Fate of pollutants, *Estuaries, Hydrocarbons, *Oil industry, Estuarine environment, *Great Britain.

Southampton Water, which is a major estuary in Great Britain, receives a variety of industrial discharges, the largest of which is from a petroleum refinery at Fawley. The seawater waste derived from cooling and processing and discharged to the estuary contains some dissolved, dispersed, and particulate adsorbed heavy and floating oils. Laboratory experiments were conducted to investigate the various biological, chemical, and physical processes which would act on these effluents close to the point of discharge. The effects of such processes as biodegradation, evaporation and bubble ejection, and adsorption of hydrocarbons by estuarine sediments on refinery effluent incubated in glass containers were investigated. The adsorption of petroleum hydrocarbons by estuarine sediments appears to be the most important removal mechanism within the time scale of the estuarine system. In the laboratory studies, 70% of the hydrocarbons originally in the water column were found in the sediments after 1 hour. The initial concentration of the hydrocarbons in the effluent appears to be the rate-determining factor for the adsorption. Compounds of high water solubility were found to be adsorbed to a lesser extent than the less soluble compounds. This rapid near-source sedimentation can be expected to create a deposit of petroleum hydrocarbons which are available for release to the aqueous environment over an extended period. (Carroll-FRC)
W82-05144

ANTHROPOGENICALLY DERIVED CHANGES IN THE SEDIMENTARY FLUX OF MG, NI, CU, ZN, HG, PB, AND P IN LOUGH NEAGH, NORTHERN IRELAND,
University of New Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey, R. J. Murphy, and S. W. Kyle.
Environmental Science and Technology, Vol 16, No 1, p 23-30, January, 1982. 5 Fig, 6 Tab, 74 Ref.

Descriptors: *Trace metals, *Bottom sediments, *Phosphorus, *History, Water pollution sources, Copper, Zinc, Lead, Mercury, Magnesium, Chromium, Nickel, *Northern Ireland, Lugh Neagh.

Several studies have reported increases in the flux of certain trace metals to the sediments of aquatic systems in industrial, rural, and remote mountain areas. The concentration-depth behaviors of magnesium, chromium, nickel, copper, zinc, mercury, lead, and phosphorus in three sediment cores from a central site in Lough Neagh, Northern Ireland, were examined for changes in the sedimentary flux of these elements. Lough Neagh is a large, relatively shallow lake with a mainly rural catchment which has become eutrophic due to increases of phosphorus loading. Two main periods of change were found. Widespread and comprehensive woodland clearance in the 17th century resulted in a change in the catchment erosion-leaching regime which produced increased sedimentary magnesium, copper, and lead concentrations. A second and more significant change occurred after about 1880 A.D. The concentrations of chromium, copper, zinc, mercury, lead, phosphorus and, to a lesser degree, nickel were found to increase toward the sediment surface. Differing phosphorus and trace metal profiles, a comparison of the estimated anthropogenic sedimentary flux with background atmospheric conditions, and a general comparison with other situations all suggest that background

atmospheric sources make a substantial contribution to more recent contamination of the sediment with copper, zinc, mercury, and lead. These results indicate that the anthropogenic component of the sedimentary flux of chromium, nickel, copper, zinc, mercury, lead, and phosphorus is important in this rural environmental setting and that the trace-metal contamination of Lough Neagh is part of a global pattern. (Carroll-FRC)
W82-05145

HUMIC SUBSTANCES,
J. Josephson.
Environmental Science and Technology, Vol 16, No 1, p 20A, 24A, January, 1982. 1 Fig.

Descriptors: *Decomposing organic matter, Water pollution, *CHemical reaction, *Biochemistry, Humic acids, *Fate of pollutants, Chemical analysis, Model studies.

Increasing attention is being focussed on the chemistry and biochemistry of humic substances as a result of their known and perceived threats to safe water. Humic substances, which are formed when living matter dies and decays, react with metals, anions, organics, and chlorine, forming compounds which present health and environmental hazards. The Symposium on Terrestrial and Aquatic Humic Materials, held at Chapel Hill, North Carolina in November, 1981, was convened to exchange ideas and information on the structure, composition, identification, quantification, and control of humic substances and their reaction products. Humic substances absorb and increase the environmental distribution of inorganic and organic micropollutants. Since humic substances are composed of the reaction products of a large number of other compounds, their molecular structures are generaly hard to identify. Examination of their breakdown prducts may provide some clues to their structures. Comparison of the properties of natural humic material with those model synthetic polymers made from likely precursors might also provide insights into their structures. Studies using calcium as a model for reactions were used to examine the removal of humic subtances from solution in natural waters and the treatment of water supplies. Very little information is currently available on the effects of the binding which occurs between humic substances and free metal ions, anions, and/or other radical and molecular groups with which humic substances could react or on the effects of the breakdown of these compounds, although research in this area is beginning. (Carroll-FRC)
W82-05148

EFFECTS OF ACID PRECIPITATION,
Environmental Protection Agency, Corvallis, OR.
For primary bibliographic entry see Field 5C.
W82-05149

FINGERPRINTING INORGANIC ARSENIC AND ORGANOARSENIC COMPOUNDS IN THE SITU OIL SHALE RETORT AND PROCESS WATERS USING A LIQUID CHROMATOGRAPH COUPLED WITH AN ATOMIC ABSORPTION SPECTROMETER AS A DETECTOR,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W82-05151

THE USE OF ALGAE AS BIOLOGICAL ACCUMULATORS FOR MONITORING AQUATIC POLLUTANTS,
Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.
For primary bibliographic entry see Field 5A.
W82-05163

THE TRANSPORT TO AND DEPOSITION OF AMERICIUM IN INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY AND ITS RELATIONSHIP TO PLUTONIUM,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Environmental Pollution, Series B, Vol 3, No 1, p 1-9, 1982. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Sediment transport, *Nuclear wastes, Americium-241, Marine sediments, Plutonium, Water pollution sources, *Radioactive wastes, *Ravenglass Estuary, *Great Britain.

The Ravenglass estuary is of radioecological interest, as it is a site of sediment accumulation close to the Windscale nuclear fuel reprocessing facility. Results are presented of analyses of americium-241 in four cores collected from the Newbiggin area at Ravenglass. Surface segments ranged in Am-241 activity from 48.8 to 60.0 pCi/g. In all four cores, greater Am-241 activities were found at depth and in the buried sediments. Greatest activities were found at a few centimeters depth in the sediments. The occurrence of Am-241 peak activities at lesser depths than predicted in the sediments has been interpreted as resulting from a finite lag-time of transport from Windscale to the estuary. The best estimate of this lag time is about 2.5 years.
W82-05178

SULPHUR IN THE ENVIRONMENT: A REVIEW,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
K. A. Brown.
Environmental Pollution, Series B, Vol 3, No 1, p 47-80, 1982. 1 Fig, 5 Tab, 124 Ref.

Descriptors: *Sulfur, *Environmental effects, Sulfates, Sedimentation, Nutrients, Cycling nutrients, Marine sediments, Reviews, Sulfur cycle, Soil chemistry, Sulfides, Lakes, Lake sediments, Geochemistry, *Path of pollutants.

The path of sulfur compounds released into the atmosphere by man and by natural processes is reviewed, along with their transformation in the atmosphere and deposition to the earth's surface. The size and nature of the sources and sinks of sulfur in soils are discussed in relation to bio- and geochemical processes which govern the soil sulfur cycle, in particular organic matter transformations and mechanisms of sulfur oxidation and reduction. Environmental effects of sulfur pollution in soils and freshwater systems are considered, and the sulfur budget for a freshwater lake is discussed. Sulfur turnover in a freshwater system is compared with that of the marine environment. In fresh waters, most problems arising through sulfur pollution are caused by sulfate reduction to highly toxic sulfide, or by cations associated with sulfate, the direct toxicity of the sulfate anion being extremely low. Eutrophication does not occur as a result of sulfur pollution because sulfate is probably never growth limiting in natural waters. Sulfate can change the path of carbon mineralization in anaerobic sediments by inhibiting methanogenesis, although the significance in nature of this observation is not known. Sulfate reduction in marine sediments may be a major pathway of carbon mineralization. Most of the iron sulfides present in reduced marine sediments have arisen through bacterial sulfate reduction, rather than from degradation of organic matter. (Baker-FRC)
W82-05179

MICROCOMPUTER WATER QUALITY SIMULATION MODEL,
Camp, Dresser and McKee, Inc., Waltham, MA.
For primary bibliographic entry see Field 7B.
W82-05191

ELIMINATION OF HEXACHLOROBENZENE (HCB) BY RAINBOW TROUT (SALMO GAIRDNERI), AND AN EXAMINATION OF ITS KINETICS IN LAKE ONTARIO SALMONIDS,
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and C. Y. Cho.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1350-1356, November, 1981. 4 Fig, 1 Tab, 36 Ref.

Descriptors: *Benzenes, *Chlorine, *Trout, *Lakes, Pollutants, Water pollution, Fish, Kinetics, Mathematical equations, *Industrial wastes, Lake Ontario, *Hexachlorobenzene, Pesticides.

The extensive use and worldwide distribution of hexachlorobenzene (HCB), which is an industrial chemical frequently found in wastewaters, have led to increased concern about its becoming an important environmental contaminant. The rate of elimination of HCB by rainbow trout was established and then related to earlier studies that examined HCB uptake from food and HCB levels surveyed in salmonids from Lake Ontario. Subadult rainbow trout (Salmo gairdneri) were fed diets containing HCB to establish mean body burdens of 225 and 440 micrograms HCB per fish. The rate of elimination was then estimated by sampling conducted after 0, 24, 55, and 110 days. Results of these tests showed that the biological half-life of HCB for these trout was at least 7 months, and perhaps as long as several years. The implications of increasing body weight for kinetics measurements are discussed, and an equation is presented which can be used to adjust for changes in body weight where estimates of half-lives are calculated using tissue concentrations. Use of this information in examining the kinetics of HCB in salmonids collected from Lake Ontario resulted in good agreement between the expected level and that monitored in field samples of rainbow trout, but only fair agreement for lake trout and coho salmon. Differences in the HCB kinetics of these species may be attributed to body weight, age, and perhaps feeding habits. Field sampling programs have resulted in reports of HCB concentrations ranging from 1 to 100 micrograms per kilogram in fish. These levels are probably due primarily to the limited availability of HCB in the Lake Ontario environment. (Carroll-FRC)
W82-05195

GROUND-WATER HYDROLOGY AROUND SALT DOMES IN THE EAST TEXAS BASIN: A PRACTICAL APPROACH TO THE CONTAMINANT TRANSPORT PROBLEM,
Texas Univ. at Austin. Bureau of Economic Geology.
G. E. Fogg, and C. W. Kreitler.
Bulletin of the Association of Engineering Geologists, Vol 18, No 4, p 387-411, 1981. 15 Fig, 1 Tab, 44 Ref.

Descriptors: *Groundwater pollution, *Geohydrology, *Salt domes, Aquifer systems, Waste disposal, Aquitards, Groundwater recharge, Groundwater movement, Radioactive waste disposal, *Texas.

Salt domes in the East Texas Basin are being studied as potential sites for deep burial of nuclear waste. This paper presents a report on progress being made in a program designed to characterize the capability of each of two domes, Oakwood and Keechi, and surrounding media to isolate radioactive wastes. The program includes study of factors which control vulnerability of a dome repository to failure, such as dome growth, cap rock development, and salt dissolution, and of factors which determine how radionuclides would be transported away from a dome should a failure occur. Waste escaping from either dome would, at worst, move into either the Wilcox-Carrizo, a thick, semiconfined, fresh-to-brackish groundwater system, or into the Woodbine Formation, a deeper, saline aquifer. The potential for upward discharge from the Woodbine to the Wilcox-Carrizo appears to be nonexistent at present. Potential impacts of a nuclide escape from the domes into the Wilcox-Carrizo would depend in large part on how deeply recharge over each dome would move contaminants downward and on whether the contaminants would then migrate toward discharge areas in the basin due to topographic effects. Orientation of a moderately brackish-water plume extending away from the Oakwood dome implies topographic control on flow and suggests that contaminants escaping from the dome would become significantly diluted within 5 or 6 miles along the pathway. Groundwater chemistry indicates a trend toward greater capacity for attenuation of radionuclides as fluids move from recharge areas into more alkaline, reducing environments in the artesian sections of the Wilcox-Carrizo. (Carroll-FRC)
W82-05202

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AN ENVIRONMENTAL HEALTH SURVEY OF DRINKING WATER CONTAMINATION BY LEACHATE FROM A PESTICIDE WASTE DUMP IN HARDEMAN COUNTY, TENNESSEE,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
C. S. Clark, C. R. Meyer, P. S. Gartside, V. A. Majeti, and B. Specker.
Archives of Environmental Health, Vol 37, No 1, p 9-18, January-February, 1982. 2 Fig, 10 Tab, 24 Ref.

Descriptors: *Carbon tetrachloride, *Drinking water, Industrial wastes, Aquifers, Groundwater contamination, Well water, Wells, Path of pollutants, Potable water, Public health, Leaching, *Leachates, Hazardous wastes, *Waste dumps, Human disease, Liver, Hardenman County, *Tennessee.

By late 1978 officials of the Environmental Protection Agency had detected more than 12 chlorinated organic compounds in wells serving individuals living near the Hardeman County, Tennessee, toxic waste dump. The most abundant toxic substance detected was carbon tetrachloride. Sixty-one individuals in 16 households used water from wells containing carbon tetrachloride in concentrations exceeding 150 micrograms/liter. Two health evaluations were made. Fifty-nine of the 61 individuals participated in at least one of the two studies; 31 participated in both. Others examined included individuals with less contaminated wells and individuals who had been occupationally exposed to pesticides, including those who had worked at the dump site. The study conducted included a health questionnaire, a clinical examination, and a biochemical screening, with analysis of serum for liver and kidney function parameters, determination of hepatitis A and B serology, and bile acid determinations on fasting and postprandial serum and urine specimens. Initial hepatic profile testing revealed elevated concentrations of the serum enzymes, alkaline phosphatatase and serum glutamic oxaloacetic transaminase in residents using contaminated water. During follow up examinations two months later, these values had dropped significantly, as had postprandial serum concentrations of the bile acids of cholyglycine. The findings suggest a transitory liver injury probably related to exposure to the contaminated drinking water. (Baker-FRC)
W82-05203

INFLUENCE OF WATER MOVEMENTS AND OTHER FACTORS ON DISTRIBUTION AND TRANSPORT OF HEAVY METALS IN A SHALLOW BAY (CANADA),
Alberta Environmental Centre, Vegreville.
J. W. Moore.
Archives of Environmental Contamination and Toxicology, Vol 10, No 6, p 715-724, December, 1981. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Heavy metals, *Bays, Water pollution, Bottom sediments, Cyanide, Arsenic, *Mine wastes, Lead, Copper, Zinc, Mercury, Iron, *Canada, *Path of pollutants, Great Slave Lake, *Yellowknife Bay.

Yellowknife Bay, which is situated on the north slope of Great Slave Lake in northern Canada, receives a continuous discharge of liquid mine wastes, including heavy metals, salts, and cyanide, from an operating gold mine. The concentrations of heavy metals in the water and sediments of the bay were measured and correlated with water movement, water depth, distance from the waste source, and the organic content of the sediments. Arsenic reached a maximum concentration of 3100 milligrams per kilogram in sediments near the waste source, decreasing to less than 12 milligrams per kilogram in the extreme reaches of the bay. The corresponding ranges for other heavy metals were 13 to 800 milligrams of lead per kilogram, 45 to 785 milligrams of copper per kilogram, 23 to 935 milligrams of zinc per kilogram, 35 to 505 micrograms of mercury per kilogram, and 1.9% to 6.3% iron. Although most pollutants were recorded at low levels in the water, arsenic and copper rose to 0.75 and 0.29 milligrams per liter, respectively, coincident with maximum discharge from the mine. The most important factor governing the distribution of metals in the bay was found to be water movement, generated by inflowing rivers and wind. While surrounding islands also restricted the movement of pollutants through the bay, water depth, slope of the bottom and organic content of the substrate did not appear to have a significant impact on the concentrations of heavy metals in the sediments. (Carroll-FRC)
W82-05205

AN EVALUATION SYSTEM TO RATE FEEDLOT POLLUTION POTENTIAL,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
R. A. Young, M. A. Otterby, and A. Roos.
Agricultural Reviews and Manuals ARM-NC-17, April 1982. 82 p, 3 Fig, 3 Tab, 48 Ref, 6 Append.

Descriptors: *Feedlot runoff, *Animal wastes, *Water pollution sources, *Computer models, Feedlot wastes, Water pollution control, Groundwater pollution, Minnesota, Chemical oxygen demand, Phosphorus, Forecasting, Pollution potential.

An evaluation system was developed through the cooperation of several State and Federal agencies to provide a uniform and objective method of evaluating and rating the pollution potential of the approximately 90,000 animal feedlot operations in Minnesota. The first part of the evaluation consists of five simple questions which can be answered by the feedlot operator, allowing the person making the evaluation to disregard the feedlot immediately if it is definitely not a pollution hazard. If the screening procedure indicates a potential hazard, then a more detailed evaluation form must be completed. The first step is to study the animal lot and the area around it to determine the local watershed, and then sketch the watershed. The next step is to determine the design rainfall for which the feedlot is to be determined. For this model, chemical oxygen demand and phosphorus were selected to represent the potential pollution hazard. The soil cover complex method is used to estimate runoff from rainfall for each area included in the local watershed. Equivalent animal units (EAU) are determined from tables and used as a unit of measure to compare differences in the production of waste constituents by different animal species. Other factors considered in this model include: animal unit density; concentration of runoff at feedlot edge; contact time; pollutant reduction from filtration; and concentration reduction from dilution. Once the final concentration of the runoff at the discharge point is estimated, the pollution hazard can be developed. (Moore-SRC)
W82-05207

RESULTS OF DEEP-WELL INJECTION TESTING AT MULBERRY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey, and W. E. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-193004, Price codes: A02 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 81-75, 1982. 15 p, 7 Fig, 5 Ref.

Descriptors: *Injection wells, *Industrial wastes, *Transmissivity, *Aquifer characteristics, Geohydrology, *Liquid wastes, Carbonate rocks, Aquitards, Leakage, Groundwater barriers, *Florida, Mulberry, Waste disposal.

At the Kaiser Aluminum and Chemical Corporation plant, Mulberry, Fla., high-chloride, acidic liquid wastes are injected into a dolomite section at depths below about 4,000 feet below land surface. In 1975, a satellite monitor well was drilled 2,291 feet from the injection well and a series of three injection tests were performed. Duration of the tests ranged from 240 to 10,020 minutes and injection rates ranged from 110 to 230 gallons per minute. Based on an evaluation of factors that affect hydraulic response, water-level data suitable for interpretation of hydraulic characteristics of the injection zone were identified to occur from 200 to 1,000 minutes during the 10,020-minute test. Transmissivity of the injection zone was computed to be within the range from 700 to 1,000 feet squared per day and storage coefficient of the injection zone was computed to be within the range from .00001 to .00005. The confining bed accepting most of the leakage appears to be the underlying bed. Also, it appears that the overlying beds are probably relatively impermeable and significantly retard the vertical movement of neutralized waste effluent. (USGS)
W82-05224

A PRELIMINARY APPRAISAL OF THE EFFECTS OF AGRICULTURE ON STREAM QUALITY IN SOUTHWEST GEORGIA,
Geological Survey, Doraville, CA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-05229

A WIND-POWERED, GROUND WATER MONITORING INSTALLATION AT A RADIOACTIVE WASTE MANAGEMENT SITE IN IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
J. C. Bagby, G. E. Ghering, R. G. Jensen, and J. T. Barraclough.
Geological Survey Water Resources Investigations Open-File Report 81-493, April 1981. 28 p, 14 Fig, 1 Tab, 2 Ref.

Descriptors: *Radioactive waste disposal, *Groundwater, *Monitoring, *Water quality, Path of pollutants, Geohydrology, Waste storage, Water pollution sources, Aquifers, Wells, Contamination, Pumping, Water level, Water sampling, Data collections, *Idaho, Snake River Plain, *Idaho National Engineering Laboratory.

In 1971, four wells were drilled just outside a radioactive solid waste storage and disposal facility located on the Idaho National Engineering Laboratory in southeastern Idaho. This facility, the Radioactive Waste Management Complex (RWMC), has been in use since 1952. These wells serve several purposes: to study the geology and hydrology at the RWMC, to determine the potential for radioactive waste migration, and to obtain water samples to determine if waste products are migrating downward into the Snake River Plain aquifer. Special efforts are made to insure that surface contamination does not enter the wells by either water, wind, or contaminated equipment. A submersible pump and a continuous water-level measuring device were installed in each well. Permanent installation of this equipment allowed the well heads to be sealed while providing for collection of data from these wells. The water-level measuring device is a small diameter, differential-pressure, transducer probe. The transducer produces a variable-reluctance signal which is converted to an analog signal and recorded as the depth to water on a strip chart recorder. Windmill-charged storage batteries provide power for the water-level measuring system. This system is reliable, sensitive, and relatively maintenance free. (USGS)
W82-05233

ASSESSMENT OF WATER QUALITY IN STREAMS DRAINING COAL-PRODUCING AREAS IN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
C. L. Pfaff, D. R. Helsel, D. P. Johnson, and C. G. Angelo.
Geological Survey Water Resources Investigations Open-File Report 81-409, October 1981. 98 p, 17 Fig, 7 Tab, 43 Ref, Append.

Descriptors: *Water quality, *Streams, *Acid mine drainage, *Water pollution sources, *Data collections, Mine wastes, Strip mines, Geohydrology, Statistical analysis, Sampling, Chemical analysis, *Ohio, Coal mines.

Water quality in the coal-producing areas of eastern Ohio was studied in a two-phase investigation between May 1975 and August 1976. Results of

phase one, a reconnaissance of water quality at 150 sites, indicated that acid mine drainage generally occurred where abandoned drift or strip mines were located, whereas areas characterized by reclaimed or active strip mines showed few instances of acid drainage. Phase two was a detailed study of four small basins: One contained abandoned drift mines; the second, abandoned strip mines; the third, reclaimed strip mines; the last, active strip mines. Results of phase two were similar to those of phase one. (USGS)
W82-05234

DYNAMICS OF THE NUMBER OF BACTERIA AND CONVERSION OF READILY OXIDIZABLE SUBSTANCES IN SMALL RIVERS,
Tallin Polytechnic Inst. (USSR).
For primary bibliographic entry see Field 5A.
W82-05237

CONTAINMENT AND TREATMENT OF THE LOVE CANAL LANDFILL LEACHATE,
Niagara Falls Wastewater Treatment Plant, New York.
For primary bibliographic entry see Field 5D.
W82-05250

SULFUR BACTERIAL PROBLEMS REVISTED,
S. Smith.
Water Well Journal, Vol 36, No 2, p 45-46, 1982. 7 Ref.

Descriptors: *Bacteria, *Sulfur, *Corrosion, *Hydrogen sulfide, Water quality, Water analysis, Chemical analysis, Well water, Wells, *Water pollution sources.

There are two very distinct forms of bacteria which interact with sulfur compounds to cause water problems. First there are sulfur or sulfide oxidizers, which are aerobic and require oxygen for growth. The second group are the sulfate-reducers (SRB), which generate hydrogen sulfide and are implicated in the corrosion of iron and steel as well as concrete and other materials subject to attack by hydrogen sulfide. Sulfur bacteria live and act as part of a very complex system of interacting soil chemistry and bacteria. They are the primary agents responsible for the cycling of sulfur compounds through the biosphere, although inorganic processes do remove the bulk of the mineral sulfur through simpler cycles involving sulfide minerals. Sulfur bacteria are found in almost every imaginable environmental condition. Detection and treatment of sulfur bacteria infestations are considered. The simplest and most reliable means of detection is microscopic examination, providing that enough material is present. Treatment for sulfate reducing bacteria is fairly routine. All sulfur bacteria are killed by chlorination. SRBs are also controlled by aeration, since oxygen is poisonous to them. Use of chlorinated drilling water and the avoidance of introducing soil into the borehole are helpful. During routine bacterial tests for coliform types, laboratory tests should also be run to determine iron and sulfur bacteria. (Baker-FRC)
W82-05264

THE DISSIPATION OF NONYLPHENOL IN STREAM AND POND WATER UNDER SIMULATED FIELD CONDITIONS,
Forest Pest Management Inst., Sault Ste. Marie (Ontario).
K. M. S. Sundaram, and S. Szeto.
Journal of Environmental Science and Health, Part B, Vol 16, No 6, p 746-776, 1981. 4 Fig, 10 Ref.

Descriptors: *Microbial degradation, *Organic compounds, Streams, Ponds, Biodegradation, Sediments, Sedimentation, Nonylphenol, *Fate of pollutants, Aquatic environment, Northland Creek, Hargraft Lake, *Ontario, Canada.

The behavior of nonlyphenol was investigated in a static aquatic environment. Natural waters and pond sediment were taken from Northland Creek and Hargraft Lake, northeast of Sault Ste. Marie, Ontario, Canada. Nonylphenol was rapidly dissipated from both stream and pond water when incubated in open flasks at 16 degrees C under simulated field conditions in the environmental chamber. The concentrations decreased exponentially. Nonylphenol persisted much longer in both stream and pond water when incubated in flasks closed with polyethylene snap caps under identical environmental conditions. A transformed product was detected in both stream and pond water when incubated in closed flasks for more than 3 days. The transformed product is probably more polar than the parent, since its retention time was shorter than that nonylphenol in reverse-phase solvent elution, Its formation may be due to photooxidation or microbial hydroxylation of nonylphenol in the aquatic system. The presence of sediment greatly reduced the loss of nonylphenol from pond water through surface volatilization and codistillation. Most of the nonlyphenol adsorbed onto the particulate matter in suspension and then gradually settled in the sediment. Less than 5% of the added nonlyphenol was still present in water incubation for 4 days, and nonlyphenol was no longer detected in water after 10 days. Nonylphenol persisted in autoclaved sediment, but disappeared rapidly in ono-autoclaved sediment. These findings suggest that nonlyphenol was rapidly lost in natural sediment due to microbial degradation. (Baker-FRC)
W82-05273

RETENTION OF URBAN DERIVED PHOSPHORUS BY AN ALLUVIAL SWAMP OF THE COASTAL PLAIN OF GEORGIA,
Georgia Southwestern Coll., Americus. Dept. of Biology.
W. L. Tietjen, and J. C. Carter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224635, Price codes: A05 in paper copy, A01 in microfiche. Report ERC 05-81, July 1981. 68 p, 2 Fig, 17 Tab, 21 Ref. 2 Append. OWRT A-084-GA(1).

Descriptors: *Phosphorus, *Alluvial deposits, *Swamps, *Retention time, Retention capacity, Urban runoff, Urban drainage, Wastewater, Phosphorus removal, Alluvial rivers, Streams, Detention time, Settling basins, *Nutrient removal, Wastewater facilities, Wastewater treatment, Effluent streams, Effluents, Enrichment, Muckalee Creek, *Georgia, Coastal plains, Urban sewage effluent.

The alluvial swamp system of Muckalee Creek near Americus, Georgia was studied for the entire year of 1979 to determine its capability for retaining phosphorus (P) derived from sewage treatment plant effluent and other urban sources. Retention was determined by comparing the swamp P influx (enrichment) from the urban sources, with P outflux five kilometers further downstream. The annual P aqueous concentration in water above the enrichment point was 0.05 mg P/liter, while that below this point was 0.17 mg P/liter. The annual mean estimates for P movement rates were 0.52, 0.84, 0.45, 1.44, and 0.37 g P/second for input sewage, unknown urban sources, upstream contribution, stream transport out of the swamp, and total retention within the swamp, respectively. Only about 20% of the incoming P was retained by the swamp, with an estimated 6.11 g P/ sq m/year. The P accumulation rate in soil sediments is unknown, but it appears that the swamp soil is the major sink for swamp P retention. The data suggest that the contention that the swamp is important in retaining urban-derived P is sound. (Zielinski-MAXIMA)
W82-05286

ACID PRECIPITATION IN THE WASHINGTON CASCADES,
Central Washington Univ., Ellensburg. Dept. of Chemistry.
L. C. Duncan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224643, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1981. 20 p, 5 Fig, 5 Tab, 22 Ref. OWRT A-110-WASH(1), 14-34-0001-1151.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Water analysis, *Sulfuric acid, *Air pollution effects, Rainfall, Air pollution, Fallout, Acidic water, Acidity, Sulfates, Seasonal variation, Watersheds, Catchment areas, Rainfall impact, Local precipitation, Water quality, Pollutants, Ecological effects, Environmental effects, *Washington Cascades, Water pollution sources.

Five sites maintained across the Washington Cascades from January-June 1981 sampled precipitation for determinations of its potential acidity. The precipitation collected at each site was acidic in that the average pH values were substantially below pH 5.6, a level expected for waters containing only equilibrium concentrations of dissolved carbon dioxide. The pH values varied somewhat with lcoation. Sulfate was the dominant negative ion at all sites, even after correction for sea-salt input. The mean strong acid composition over the sites ranged 50-57 weight-% H2S04. Precipitation falling on the Cascades east and windward of the urban Puget Sound area was notably acidic, with a volume average pH of 4.71 at the Cascade Crest (Snoqualmie Pass). Strong acid content in precipitation increased in the summer months. In addition, 29 watershed source lakes lying along the Cascade Crest 3-20 miles north of the site collectors were sampled in the summer of 1981; all lakes were found to be highly sensitive (but not acidified), with alkalinities ranging from 4-190 microequivalents/liter (mean value of 50.4). The lakes were nonetheless, considered to be highly susceptible to acid input, being in a region of thin top soil and resistant strata. (Zielinski-MAXIMA)
W82-05287

NONPOINT SOURCE POLLUTION FROM AGRICULTURAL WATERSHEDS ON COASTAL PLAIN SOILS,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224650, Price codes: A03 in paper copy, A01 in microfiche. Report, April 1981. 31 p, 4 Fig, 17 Tab, 12 Ref. OWRT A-046-DEL(1), 14-34-0001-9008.

Descriptors: *Nonpoint pollution sources, *Agricultural watersheds, *Nitrogen, *Phosphorus, Water analysis, Pollution load, Watersheds, Chemical oxygen demand, Waste load, Organic loading, Nitrogen compounds, Nitrates, Ammonia, Water quality, Model studies, Watershed models, Rainfall, Base flow, Storm runoff, *Delaware, *Coastal plains.

A study was conducted on two rural agricultural watersheds in southern Delaware to obtain information on nitrogen (N) and phosphorus (P) loading rates, and to develop data for future water quality modeling efforts. The amount of rainfall N and P was found to be greater than the nonpoint source N and P loading rates. Over 50% of the N, P, and chemical oxygen demand (COD) loads occurred in baseflow. A larger relative percentage of total P, COD, and organic N was transported during storm runoff than nitrate-N. However, there was no observed relationship between N and P concentrations and flowrate for either watershed. Installing best management practices would not greatly affect the reduction of N and P loads. The two watersheds were monitored for a two-year period, with storm runoff, baseflow samples, and rainfall analyzed for nitrate-N, ammonia, organic N, orthophosphorus, total P, COD, and pH. In 1979, the total N and P loading rates were 24.7 and 1.3 kg/ha for one watershed, and 20.8 and 1.4 kg/ha for the other. (Zielinski-MAXIMA)
W82-05291

STUDIES OF NITRIFICATION IN A COKE-WASTE ACTIVATED SLUDGE PROCESS,
Alabama Univ., Birmingham. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-05295

REDUCED RUNOFF AND NONPOINT SOURCE POLLUTION THROUGH INCREASED INFILTRATION,
Pennsylvania State Univ., University Park.

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For primary bibliographic entry see Field 2G.
W82-05300

METAL CONCENTRATIONS IN GUAM URBAN RUNOFF,
Guam Univ., Agana. Water and Energy Research Inst.
W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224775, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 25, June 1981. 27 p, 5 Fig, 8 Tab, 19 Ref, 2 Append. OWRT A-011-GUAM, 14-34-0001-9012.

Descriptors: *Urban runoff, *Heavy metals, *Water analysis, *Water pollution sources, *Water quality standards, *Guam, Runoff, Urban drainage, Urban areas, Mercury, Lead, Cadmium, Hydrogen ion concentration, Hardness, Contamination, Water pollution, Water quality, Recharge basins, Watersheds, Watershed management, Groundwater basins.

Northern Guam serves as a recharge watershed for the groundwater aquifer that supplies most of Guam's drinking water. Samples from five sites in northern Guam which best characterize runoff from commercial and residential areas were analyzed for heavy metals to assess the potential for aquifer contamination. The 13 metals investigated were arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc. Analyses revealed low levels (in the microgram/liter range) of these metals. Mercury, lead, and cadmium approached/exceeded drinking water standards as dissolved metals in urban runoff. Chromium, copper, iron, manganese, nickel, and zinc were below drinking water standards, but approached/exceeded surface water standards. Other metals analyzed were very low. Suspended metal concentrations were generally higher than dissolved metal concentrations. Metal concentrations in commercial runoffs far exceeded those in residential runoffs. However, commercial runoff waters are discharged in a manner that does not pose a threat to groundwaters used for drinking water. It was concluded that the metal levels found were generally lower than observed in other U.S. communities. Other data (such as pH, total solids, hardness) indicate that urban runoff quality has not changed in the past four years. Further study is needed to determine the distribution of metals in Guam's environment. (Zielinski-MAXIMA)
W82-05302

SEPTIC LEACHATE SURVEYS FOR LAKESIDE SEWER NEEDS EVALUATION,
K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot, and S. M. Skinner, Jr.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1717-1725, December 1981. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Septic wastewater, *Water pollution sources, *Leachates, Septic tanks, Lakes, Sewer systems, *Lake shores, Groundwater, *Crystal Lake, *Michigan.

A review of wastewater facilities planning for rural lake communities showed that facility plan proposals often viewed the existence of shoreline septic facilities as a priori evidence of water quality problems, that only casual efforts were made to determine whether any cause-and-effect relationships existed between individual septic systems and perceived water quality problems, and that public health officials were generally unprepared to provide comprehensive information on actual water quality and the effect on public health from shoreline septic systems. A specially designed survey was conducted along the shoreline of Crystal Lake in northern Michigan to demonstrate a method for increasing the effectiveness of evaluation of septic systems. The performance of shoreline on-lot treatment systems was analyzed through the use of a newly developed septic leachate detector, a groundwater flow meter, a surface and groundwater sampling program, and mathematical techniques for evaluating the condition of groundwater plumes. Three different types of discharges from malfunctioning shoreline systems were identified by the survey: erupting groundwater plumes, dormant (seasonal) groundwater plumes, and surface-water plumes. The position and density of plumes were related to the observed flow of shoreline groundwater. The survey showed that more than 90 groundwater plumes of wastewater origin were entering the shoreline from the 1090 seasonal and year-round residences. The greatest frequency of erupting plumes was found along the unsewered shoreline. A high correlation was found between the location of emergence of plumes and attached plant growth, particularly Cladophora. There did not appear to be any significant change in surface water nutrient contents as a result of plume emergence. The location and characteristics of emergent plumes were directly related to the prevailing groundwater flow. (Carroll-FRC)
W82-05322

RANDOM DIFFERENTIAL EQUATIONS IN RIVER WATER QUALITY MODELING,
Humboldt State Univ., Arcata, Dept. of Engineering.
For primary bibliographic entry see Field 6A.
W82-05343

HYDRODYNAMIC DISPERSION DURING ABSORPTION IN A FINE SAND 1. THE CONSTANT CONCENTRATION CASE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
Water Resources Research, Vol 18, No 1, p 91-100, February, 1982. 8 Fig, 14 Ref.

Descriptors: *Solute transport, *Absorption, *Dispersion coefficient, Numerical analysis, Sand, Hydrodynamics, Unsaturated flow, Soil water, Path of pollutants.

This paper reports results of the investigation of the velocity dependence of the hydrodynamic dispersion coefficient for a fine sand during horizontal adsorption of a solute under constant concentration conditions. Experimental data obtained with Bungendore fine sand was compared with quasian-alytical solutions using constant-valued dispersion coefficients and with numerical solutions. Agreement was good when a constant dispersion coefficient of 10 to the minus 8th power sq m per sec was used. Results from computer-based numerical analysis agreed well with the integral solution. Concentration profiles obtained from numerical analysis in the case of a velocity-dependent dispersion coefficient had less scatter than experimental data. Therefore, the velocity-dependent effect cannot be described solely on the basis of experimental data. The fact that the Peclet numbers appropriate to the system were greater than unity suggests that the dispersion coefficient is velocity dependent and that the parameters used in the numerical analysis to express this dependence are satisfactory for Bungendore fine sand under constant concentration absorption. (Cassar-FRC)
W82-05347

SURFACE CHEMICAL THEORY AS AN AID TO PREDICT THE DISTRIBUTION AND THE FATE OF TRACE CONSTITUENTS AND POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
W. Stumm.
Water Science and Technology, Vol 14, No 1/2, p 481-491, 1982. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Adsorption, *Particulate matter, *Sedimentation, *Fate of pollutants, Surface chemistry, Mass transfer, Model studies.

Surface chemical theory provides some of the information (constants and coefficients related to adsorption and mass transfer) needed to describe the reactions occurring at the water-particulate interface and to predict the fate of pollutants in the aquatic environment. The emphasis of the discussion is adsorption of dissolved species onto aquatic particles and the role of scavenging by settling particles. Models for predicting adsorption and settling are reviewed. (Cassar-FRC)
W82-05353

IMPACT OF DISCHARGES AS A BASIS FOR CONTROL MEASURES,
Union Carbide Corp., South Charleston, WV.
R. A. Conway.
Water Science and Technology, Vol 14, No 1/2, p 95-109, 1982. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Risks, *Water quality standards, *Environmental effects, Fate of pollutants, Solute transport, Chemical reactions, Biotransformation, Ecological effects, Water pollution effects, Decision making, Model studies, Effluent standards, Data collections, Chemical wastes, Wastewater pollution, *Water pollution control.

Methods of environmental risk analysis are described as a basis for tailoring water pollution control measures to individual effluents and receiving waters. There are 4 basic approaches to environmental risk analysis. The stochastic-statistical approach establishes correlations between input of a material and results. The model ecosystem, or microcosm, tests the results of a pollutant on a physical model of an environmental situation, for example, an aquarium. The deterministic approach uses mathematical models to describe the fate and transport of pollutants in the environment. The baseline approach constructs full-scale characterizations of transport, persistence, and effects of chemicals and compares results of later pollutant additions with the original data. Tiered testing protocols start with simple screening tests to guide decision making for materials of small impact and use tests of increasing complexity as decisions having large impact are needed. Tables list some candidate tests for screening the ecological impact of new products and effluents, mechanisms affecting environmental fate of chemicals, and environmental process and properties (physical, chemical, and biological transformations and transports). Mathematical models for estimating concentrations of chemicals after transport and transformation are reviewed. (Cassar-FRC)
W82-05354

DETERMINATION OF METALS IN GROUNDWATERS BY TRACE ENRICHMENT AND LIQUID CHROMATOGRAPHY,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 5A.
W82-05361

A SURVEY OF AZINPHOS METHYL AND AZINPHOS METHYL OXON IN WATER AND BLUEBERRY SAMPLES FROM HANCOCK AND WASHINGTON COUNTIES OF MAINE,
Maine Univ. at Orono. Dept. of Food Science.
R. J. Bushway, W. Litten, K. Porter, and J. Wertam.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 341-347, March, 1982. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Insecticides, *Fate of pollutants, *Pesticides, Azinphos methyl, Guthion, *Maine, *Blueberries, Well water, Water pollution, Streams.

Water samples at seven sites in Washington and Hancock Counties, Maine, were analyzed for the insecticide azinphos methyl (guthion) and its metabolite, azinphos methyl oxon. The pesticide is sprayed extensively on low bush blueberry acreage. Azinphos methyl was detected in two locations: household well water in a sprayed field, 1900-24,000 ng per liter; and process water from a blueberry processing plant, 12,700 ng per liter. No azinphos methyl oxon was detected in any sample (detection limit, 230 ng per liter). The other five sites with nondetectable levels of azinphos methyl were two streams, a pond outlet, a clam flat area, and a tidal flat. The well water sample was analyzed several times during the summer, during which the pesticide was applied twice. The high concentration of 24,000 ng per liter was found on

July 23. The August 11 sampling showed no detectable pesticide. Most likely this reduction was caused by groundwater dilution rather than degradation. (Cassar-FRC)
W82-05376

RADIOTRACER EXPERIMENTS ON PHOSPHORUS UPTAKE AND RELEASE BY LIMNETIC MICROZOOPLANKTON,
Canada Centre for Inland Waters, Burlington (Ontario).
W. D. Taylor, and D. R. S. Lean.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1316-1321, November, 1981. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Phosphorus, *Lakes, *Microorganisms, Zooplankton, Phosphorus radioisotopes, Nutrients, Phosphate, Isotopic tracers, Metabolism, Path of pollutants, *Phosphorus uptake and release, Strombidium virde, *Ontario, Canada.

Previous studies have suggested that very small zooplankton, particularly ciliated protozoa, might be particularly important in mineralization of limnetic phosphorus. This study investigated phosphorus uptake and release by Strombidium viride, a ciliate species abundant in lake plankton. Addition of carrier-free 32P04 to lakewater resulted in gradual labeling of S. viride over at least 30 hours. The label entered the protozoa primarily by the ingestion of labeled particles 0.2 to 1.0 microns in size; direct uptake of phosphate or uptake of particles 5 microns or larger was relatively slight or absent. S. viride transferred to unlabeled lake water lost 32P by a discontinuous process, presumed to be defecation, and by a relatively slow continuous process. The latter process was presumed to be the equivalent of what is usually termed excretion for crustacean zooplankton and is equivalent to a turnover time for the animal's phosphorus content of many hours. Release experiments with the rotifer Keratella cochlearis resulted in similar total losses of 32P, although defecation provided a much larger portion of the total. The turnover times for excretion were similar for the two organisms. Analysis by gel filtration showed that the soluble phosphorus released by both species was primarily phosphate. The results of these experiments do not support the conventional view that microzooplankton regenerate dissolved phosphorus much more rapidly for their biomass than do larger crustacean zooplankton. (Carroll-FRC)
W82-05381

VARIATION IN FECAL POLLUTION INDICATORS THROUGH TIDAL CYCLES IN THE FRASER RIVER ESTUARY,
Department of the Environment, Vancouver (British Columbia). Inland Water Directorate (Pacific Region).
For primary bibliographic entry see Field 5A.
W82-05384

GROUNDWATER STRATEGY: PROTECTING A VITAL RESOURCE,
C. W. Warren.
Clearwaters, Vol 11, No 1, p 6-7, March, 1981.

Descriptors: *Groundwater, *Water resources development, *Aquifers, Contamination, Water pollution sources, *Legislation, Legal aspects, Regulations, Standards, *Water pollution control, United States.

Groundwater is seriously contaminated in many areas throughout the nation. This contamination includes a variety of materials such as toxic organic and inorganic chemicals. No federal health standards exist for most of the organic chemicals found in drinking water. There are two major sources of groundwater contamination: hazardous waste dump sites and wastewater surface impoundments. Over 600 cases of groundwater contamination due to impoundments have been reported in the nation. Even this number is probably a very low estimate of actual cases. Recent national monitoring efforts have confirmed that groundwater contamination is widespread. Frequently contaminants are found at high concentrations, due to the fact that aquifers do not provide the natural dilution which occurs in surface waters. A contaminant that penetrates groundwater tends to form a plume of highly contaminated water which moves very slowly. Clean-up of contaminated aquifers is an extremely expensive and difficult process. The most inportant laws which deal with groundwater contamination are the Federal Water Pollution Control Act, the Safe Drinking Water Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act, and the recently passed 'Superfund' legislation. The EPA is now proposing a National Groundwater Protection Strategy which should help focus on the goal of protecting the groundwater resources. (Baker-FRC)
W82-05403

EFFECT OF TURBULENT DISPERSION ON THE RATE OF AMMONIA NITROGEN IN RIVERS,
Technical Univ. of Istanbul (Turkey). Environmental Sciences Div.
D. Orhon, and E. Goneng.
Water Science and Technology, Vol 14, No 1/2, p 345-366, 1982. 20 Fig, 2 Tab, 9 Ref.

Descriptors: *Ammonia, *Turbulent flow, *Nitrification, *Fate of pollutants, Rivers, Chemical reactions, Oxidation, Biochemical oxygen demand, Shock loads, Plug flow, Industrial wastes, Fertilizers, Model studies, *Turkey, Porsuk River.

A model for predicting the fate of ammonia in rivers subject to unsteady discharges includes biochemical oxidation and longitudinal dipsersion components. Theoretical analysis and field tests on the Porsuk River determined that the concept of turbulent diffusion should be included in the model to prevent the misleading conclusions obtained when rivers are idealized as plug flow reactors. This river receives periodic loads of ammonia from a fertilizer factory. The effect of turbulent diffusion is less important at high rates of biochemical conversion. (Cassar-FRC)
W82-05418

ENVIRONMENTAL IMPACT OF THE MICROBIAL AEROSOL EMISSIONS FROM WASTEWATER TREATMENT PLANTS,
Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. R. Zenz, and S. J. Sedita.
Water Science and Technology, Vol 14, No 1/2, p 289-309, 1982. 9 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Risks, *Public health, *Microorganisms, *Chicago, Illinois, Viruses, Bacteria, Aerosols, Coliforms, Aeration, Air pollution, Water pollution effects, Fate of pollutants, *Environmental effects.

Microbial aerosol emissions from wastewater treatment plants are not a significant health risk to the population living in the vicinity of a treatment plant. This is the conclusion of a literature survey and analysis of data collected at a plant operated by the Metropolitan Sanitary District of Greater Chicago in 1979-80. Aerosol sampling in vertical profiles above the aeration tanks and 5, 25, and 50 m downwind of the aeration tanks showed that standard plate count levels of bacteria declined exponentially with distance above the tanks and linearly with distance downwind of tanks. At a distance of 50 m downwind, the fecal coliforms and total coliforms approached background levels. Net bacterial emissions (background subtracted) measured 0.3 m above 2 tanks were 0-1136 colony forming units per cu m, with geometric means of 386 and 208 cfu per cu m above each tank. No detectable animal viruses were collected 3 m downwind of the aeration tanks. (Cassar-FRC)
W82-05428

NEW TRENDS IN WATER QUALITY MANAGEMENT,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Water Pollution Control.
For primary bibliographic entry see Field 5G.
W82-05429

FATE OF SUSPENDED BIOLOGICAL SOLIDS DISCHARGED TO RECEIVING WATERS,
National Council for Air and Stream Improvement, Inc., Medford, MA.
H. S. Costa, J. J. McKeown, and D. L. Borton.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2432-2441, October, 1980. 4 Fig, 8 Tab, 19 Ref.

Descriptors: *Suspended solids, *Effluents, Sedimentation, *Sediments, Water pollution sources, Wastewater treatment, Biological treatment, Biological wastewater treatment, *Path of pollutants, *Radioactive traces, Tracking techniques.

This study was undertaken to identify and quantify the major pathways through which effluent total suspended solids are assimilated naturally in receiving waters. Effluent suspended solids were traced in a receiving stream by using a radioisotope tag. The findings suggest that the major sink for total suspended solids discharged from biological treatment systems is oxidation, while the solids remain in suspension. Effluent biosolids also were ingested and incorporated into the cellular materials of aquatic food-chain organisms in a logical food-chain pattern. The C-14 tagged biosolids discharged to the receiving water traced the effluent solids at a diluted TSS concentration of 2 mg/l. Sediment traps placed in pools behind dams captured less than 5% of the discharged solids. Over 95% of the discharged solids remained suspended or were oxidized in the stream, even though stream velocities were conducive to settling. All measureable C-14 contained in the effluent from a 1-day aerated stabilization basin was incorporated in solids that were suspended. A 31% reduction in C-14 tagged biosolids occurred during 2.5 days of plug-flow travel through an unaerated polishing pond following aerated stabilization basin (ASB) treatment. Of the amount removed in the polishing pond, 36% settled, and it was postulated that the remaining 64% exited as methane or carbon dioxide. Additional treatment consisting of aeration and quiescent detention for 0.25 day resulted in a 6% reduction in TSS. Of that amount, 48% was traced to sediment and 52% to having escaped as methane or carbon dioxide. (Baker-FRC)
W82-05448

PLANKTONIC INFUSORIA AS INDICATORS OF THE EXTENT OF ORGANIC POLLUTION IN AZERBAIDZHANIAN RESERVOIRS,
Akademiya Nauk Azerbaidzhansjoi SSR, Baku. Inst. Zoologii.
For primary bibliographic entry see Field 2H.
W82-05454

FORMS OF THE MIGRATION OF METALLIC IONS IN FRESH WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2K.
W82-05456

MANGANESE, ZINC AND COPPER IN HYDROBIONTS IN THE DANUBE AND THE NORTHWESTERN BLACK SEA,
Institute of Biology of the Southern Seas.
L. I. Rozhanskaya, and O. B. Spirandi.
Hydrobiological Journal, Vol 17, No 1, p 78-83, 1981. 1 Tab, 19 Ref.

Descriptors: *Heavy metals, *Aquatic life, *Path of pollutants, Manganese, Zinc, Copper, *Black Sea, *Danube River, Rivers, Fish, Algae, Mollusks, Metabolism, Aquatic plants.

The concentration of heavy metals by hydrobionts in the Danube and the adjacent Northwestern Black Sea was investigated. Phyllophora collected in July 1977 in the Northwestern Black Sea had a very high manganese content of 740 mg/kg wet mass. The amount of manganese in Phyllophora obtained in the same area in August was 151 mg/kg. The amount of manganese in Cystoseira was 14.0 mg/kg. The concentration of manganese in Cystoseira barbata collected in the Black Sea was considerably lower, between 1.7 and 2.4 mg/kg wet mass. Zinc content in Phyllophora was higher

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than in the other algal species, but one order lower than manganese. The amount of zinc in Phyllophora was 70.3 mg/kg in July and 26.3 mg/kg in August. The amount of zinc in Enteromorpha collected in the Black Sea along the Rumanian coast was 107 mg/kg. High zinc content was noted in the viscera of fish, especially bream, in which the content was 2920 mg/kg ash, or 70.2 mg/kg wet mass. The highest copper content was recorded in the July Phyllophora samples at 29.4 mg/kg. The high content of all trace elements in the July Phyllophora was probably connected with its growth. Almost all the young segments developing in the spring reach maturity in July. The concentration factors determined here in hydrobionts from the Danube and the Northwestern Black Sea may be used when setting standards for the pollution of water by heavy metals. (Baker-FRC)
W82-05458

CHEMICAL CHANGES OF LAKES WITHIN THE MOUNT ST. HELENS BLAST ZONE,
Washington Univ., Seattle. Fisheries Research Inst.
R. C. Wissmar, A. H. Devol, A. E. Nevissi, and J. R. Sedell.
Science, Vol 216, No 4542, p 175-178, April 9, 1982. 2 Fig, 1 Tab, 19 Footnotes.

Descriptors: *Lakes, *Volcanoes, *Water quality, Dissolved solids, Mount St. Helens, Washington, Air pollution, Fate of pollutants, Chemical composition.

Water in 12 lakes devastated by the Mount St. Helens May 18, 1980, eruption and in 4 lakes outside the blast zone were sampled on June 30, 1980. Changes in dissolved constituents depended on the lake's location relative to the lateral blast trajectory of the eruption and to the location of mineral deposits. In general Spirit Lake showed the greatest changes. Total alkalinity increased 22-fold; Mn, 815-fold; Fe, 193-fold; phosphate, 248-fold; sulfate, 157-fold; and chloride, 85-fold. K, Na, Ca, Mg, P, silicate, ammonia, Al, and Cu were enriched to a lesser degree, 13 to 40-fold. Zn, Pb, and Sb were increased from 2 to 4-fold. Enrichments of dissolved chemicals in other lakes also reflect the influences of dissolution of magmatic and lithic deposits. pH changes were minor because of buffering by carbonic acid, neutralization by mineral particles, the limited acid sulfate alteration of minerals, and dissociation of dissolved humic substances. (Cassar-FRC)
W82-05459

RADIONUCLIDES IN MONO LAKE, CALIFORNIA,
Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, R. M. Trier, J. R. Toggweiler, G. Mathieu, and B. L. Deck.
Science, Vol 216, No 4545, p 512-514, April 30, 1982. 2 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Radioisotopes, *Lake sediments, *Water pollution sources, Radioactive wastes, Adsorption, Uranium radioisotopes, Isotope studies, Radium radioisotopes, Plutonium, Thorium, Carbonates.

In the water column of Mono Lake, a natural alkaline, saline lake of California, unusually high levels of uranium (U), thorium (Th) and plutonium (Pu) have been recorded. Information on the behavior of radionuclides in natural waters may aid in assessment procedures for the isolation and storage of nuclear wastes. The enhanced solubility of actinide elements with oxidation states IV to VI was attributed to complexing with carbonate ions. After inorganic carbon was experimentally removed from lake water by acification, and the pH was adjusted to 10, over 90% of the Th and Pu moved from the aqueous to the sediment phase, while the particle concentration of U increased. Fallout strontium-90 has been largely removed from the water, most probably as a result of coprecipitation with calcium carbonate. Daughter/parent activity ratios of Th, radium, and U isotopes indicate that Th is removed from the water column on time scales much longer than a month and that the desorption of Th from sediments to the water column takes place in less than a few years. (Geiger-FRC)
W82-05461

THE IMPACT OF FISH FARMING ON WATER QUALITY,
Solway River Purification Board (Scotland).
D. J. Tervet.
Water Pollution Control, Vol 80, No 5, p 571-581, 1981. 7 Fig, 6 Tab, 16 Ref.

Descriptors: *Fish farming, *Water quality, Water use, Water pollution control, Diseases, Public health, Fish diseases, Wastewater, Fish food, Pollutants, Water pollution sources.

The dramatic increase in the fish farming industry has caused river authorities to become concerned about the pollution potential of this industry. Water quality problems resulting from fish farming include abstraction problems, pollution control problems, and disease control problems. Pollution control, which is particularly important when high densities of fish are being maintained with water of restricted availability, is caused primarily by wasted food and fecal material. In order to investigate the pollution control problems related to fish farming, a brief survey of general conditions at fish farms within the Solway River Purification Board's area in Scotland was conducted, and one particular rainbow trout rearing farm was studied in detail in order to quantify the pollution problems. These studies showed that a considerable reduction of water quality occurred on many occasions at fish farms and that these occasions were especially serious where the farms abstracted most of the water flow from a watercourse. The extent of the reduction in water quality was found to correlate closely with the weight of fish carried and the flow through a farm. It was concluded that pollution was liable to result downstream from fish farms unless annual production rates were maintained at levels well below 200 tons for each 1 cubic meter per second of available flow. This constraint is less important as the residual flow in the watercourse increases, but is significantly affected by the quality of water available. It may be necessary to install effluent treatment processes at fish farms in order to maintain current production rates. (Carroll-FRC)
W82-05471

GROUNDWATER POLLUTION INVESTIGATIONS IN THE GREAT OUSE BASIN,
Anglian Water Authority (England).
D. J. Tester, and R. J. Harker.
Water Pollution Control, Vol 80, No 5, p 614-631, 1981. 4 Fig, 6 Tab, 25 Ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Waste pollution prevention, *Water quality control, Aquifers, Leachates, Solid waste disposal, Oil spills, Great Ouse Basin, England.

The principal aquifer of the Great Ouse basin is the Chalk, which supplies over 50% of the water needs of East Anglia. Waste disposal, effluent discharges, and accidental spillage were investigated at several sites in the basin where the groundwater in the underlying aquifer was thought to be contaminated by chemical spillage, waste disposal activities, and agricultural practices. The investigations were designed to establish the extent of contamination of the aquifer in the vicinity of the site, to assess the pollution risk to abstractors and/or surface watercourses resulting from the spread of pollutants from the site and to determine any necessary remedial actions, and to provide more information on the movement and attenuation of pollutants in groudwater. The results of two case studies which provided useful information on the movement and attenuation of pollutants in the Chalk aquifer are presented. Chloride was found to be an effective tracer of sewage effluent contamination. Organic matter was found to rapidly attenuate within short distances of sewage disposal sites. The potential use of the Chalk aquifer for sewage treatment is discussed. Biological activity affects groundwater quality by depleting dissolved oxygen levels and using oxygen chemically bound to nitrate and/or sulfate. Traces of certain soluble complex organic compounds present in oil spills can persist in the aquifer and can seriously affect the quality of the groundwater. (Carroll-FRC)
W82-05475

THE OCCURRENCE OF SEWAGE-BORNE PATHOGENS IN THE UK,
Liverpool School of Tropical Medicine (England). Dept. of Parasitology.
W. Crewe, and R. R. Owen.
Water Pollution Control, Vol 80, No 5, p 632, 637, 1981. 4 Fig, 1 Tab.

Descriptors: *Pathogens, *Municipal wastewater, *Parasites, Public health, Protozoa, Trematodes, Nematodes, Cestodes, Great Britain, Water pollution sources.

A considerable number of protozoan and helminth parasites could theoretically be transmitted through sewage in the United Kingdom. The transmission of fecal-borne human parasites of humans usually depends upon human ingestion of the state of the parasite which is found in sewage following contamination of food or drink. Parasites transmitted in this way include the intestinal protozoa Entamoeba histolytica, the cause of amoebic dysentery, and Giardia intestinalis, which often causes severe diarrhea. The only trematode parasite of humans found in the United Kingdom is the sheep liver fluke, which could only be transmitted if sewage containing the eggs of the parasite were spread on pasture on which the right species of snail was breeding. Although the eggs and larvae of some common intestinal nematodes are found in considerable numbers in sewage sludges in Great Britain, they cannot be transmitted because suitable conditions for their development in soil are not common there. The nematodes Ascaris and Trichuris are transmitted, at least in small numbers, through sewage sludges used as garden fertilizers. The beef tapeworm is the only parasite of humans indigenous to the United Kingdom which is cause for concern. This parasite, which is of veterinary and economic importance, is found in sewage in the stage infective to cattle. Further information is needed before any conclusions can be drawn concerning the importance of sewage sludge in the spread of pathogens generally, and parasites specifically. (Carroll-FRC)
W82-05476

THE FATE OF ORGANIC POLLUTANTS IN FROZEN WATERS: SUNLIGHT PHOTODECOMPOSITION OF URACIL HERBICIDES IN FROZEN AQUEOUS SOLUTIONS,
Utah Water Research Lab., Logan.
A. J. Acher.
Water Research, Vol 16, No 4, p 405-410, April, 1982. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Decomposition, *Fate of pollutants, *Herbicides, *Pesticide kinetics, *Ice cover, Degradation, Hydrogen ion concentration, Pesticides, Oxidation, Irradiation, Organic pesticides, Organic compounds.

The photooxidative stability of two uracil herbicide derivatives in frozen sensitized solutions under simulated winter conditions was examined. Solutions of bromacil and terbacil were exposed directly to sunlight or covered by different thicknesses of ice. At all three pH levels tested (6.8, 8.2, and 9.1), both herbicides were rapidly decomposed by sunlight in the presence of a sensitizer, methylene blue, rose bengal or riboflavin. In the first two hours of irradiation, the maximum decomposition of bromacil and terbacil occurred in the alkaline pH range when the sensitizers were used. At pH 6.8, a practical rate of photodecomposition was found only for terbacil. When the frozen samples were covered by 11 cm of ice, the photodecomposition rates remained high enough to be of practical value. Extract residues of irradiated solutions of bromacil and terbacil contained no herbicides upon TLC and GC-MS analysis. Only small amounts of one decomposition product were found in a residue concentrate of the bromacil solution, while minute quantities of four decomposition products

were found in a residue concentrate of the terbacil solution. (Geiger-FRC)
W82-05479

INVESTIGATIONS INTO THE PROTECTIVE EFFECT OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5C.
W82-05485

BIODEGRADATION OF SYNTHETIC CRUDE OIL IN TWO RIVERS OF NORTHERN ALBERTA, CANADA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Lock, R. R. Wallace, and D. W. S. Westlake.
Water Research, Vol 16, No 4, p 497-500, April, 1982. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Oil, *Aquatic bacteria, Microbial degradation, Water temperature, Rivers, Oil pollution, Hydrocarbons, Water pollution sources.

The potential capacity of the Muskeg and Steepbank, two brown-water rivers in Northern Alberta, to biodegrade synthetic crude oil was examined in laboratory tests. The Steepbank River flows through the Athabasca oil sand deposits characteristic of this area. Samples of water and rocks were taken from various stations in December 1977 and were exposed for various periods of time to previously frozen and sterilized water samples from either river. Gas chromatographs from these incubates were compared with incubates containing known oil-degrading bacteria cultures. All samples of water and epilithon from both rivers were able to biodegrade the saturate fraction of synthetic crude oil resulting from the up-grading of oil sand suggesting that the oil degradative capability of river microorganisms was ubiquitous in this area. At 4 degrees, degradation was quite rapid, although even higher degradation rates were observed at 20 degrees. The Muskeg and Steepbank water temperatures are close to 0 degrees for about six months of the year. (Geiger-FRC)
W82-05486

FILTERING OF DISSOLVED OXYGEN DATA IN STREAM WATER QUALITY ANALYSIS,
Hawaii Univ., Honolulu. Dept. of Civil Engineering.
C. C. K. Liu.
Water Resources Bulletin, Vol 18, No 1, p 15-20, February, 1982. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Streams, Simulation analysis, Data interpretation, Decomposing organic matter, Mathematical models.

Most of the stream biological oxygen demand/dissolved oxygen water quality models currently used for the purpose of waste assimilative capacity analysis and waste load allocation in natural receiving waters are steady state models, largely due to their simplicity. In a bioligically active stream, observed dissolved oxygen content is the result of several dynamic processes, including photosynthesis and respiration actions which cause diurnal fluctuations of oxygen levels. A set of equations has been developed which can be used to separate the time varying effects of these biological activities from observed dissolved oxygen data based only on readily available field data. The resultant steady state dissolved oxygen profile allows a reasonable stream simulation based on a model and data which do not contain dissolved oxygen due to biological activities. By excluding the highly variable processes of biological dissolved oxygen production and consumption, this method significantly simplifies stream dissolved oxygen modelling. Unless changes in stream ecology are a major concern, it is desirable to formulate the stream water quality model without this time-varying term. (Carroll-FRC)
W82-05488

NITRATE REDUCTION BY PSEUDOMONAS SPP.: ANTAGONISM BY FERMENTATIVE BACTERIA,
Freshwater Biological Association, Ambleside (England).
R. W. Horsley, J. V. Roscoe, and I. B. Talling.
Journal of Applied Bacteriology, Vol 52, No 1, p 57-66, 1982. 3 Fig, 4 Tab, 32 Ref.

Descriptors: *Bacteria, *Nitrates, *Denitrification, Fate of pollutants, Nitrites, Heterotrophic bacteria, Rivers, Escherichia coli, Aeromonas hydrophila, Enterobacter aerogenes, Chemical reduction, Oxidation-reduction potential.

Pseudomonas denitrificans was incubated aerobically or anaerobically with fermentative heterotrophs (Aeromonas hydrophila, Escherichia coli, and Enterobacter aerogenes) at ratios of 100:1 to 0:100 in culture media comprised of glycerol, yeast extract, and 140 or 700 mg per liter nitrate-N. Under aerobic and anaerobic condition and with a 140 mg per liter nitrate-N concentration, 97-99% of nitrate was reduced at all ratios of A. hydrophila and E. coli with P. denitrificans. Nitrite accumulated only in the presence of pure heterotroph cultures. At the 700 mg per liter concentration of nitrate-N, 12-100% of the nitrate was reduced to nitrite in mixed cultures of P. denitrificans:heterotroph at ratios of 10:1 or less. P. denitrificans and A. hydrophila mixtures produced less nitrite than did coliforms. Inhibition of nitrate reduction was evident when 100-150 mg per liter nitrite-N had accumulated in the media. As nitrite accumulated in the 700 mg per liter nitrate-N culture, P. denitrificans decreased in number and heterotrophs slightly increased. When P. denitrificans, E. coli, and 50:50 mixtures of the two bacteria were added to autoclaved river water containing 3.5-10.0 mg per liter nitrate-N and 0.23-0.81 mg per liter nitrite-N, nitrite concentrations after incubation for 7 days at 20 C were (in mg per liter) E. coli, 1.48-5.03; P. denitrificans, 0.05-0.48; and 50:50 mixture, 0.06-1.12. (Cassar-FRC)
W82-05499

TRANSPORT PROCESSES OF COPPER AND ZINC IN A HIGHLY EUTROPHIC AND MEROMICTIC LAKE,
Eidgenoessische Anstalt fuer Wasservorgung, Abwasserreinigung und Gewaesserschutz, Kastienbaum (Switzerland). Lake Research Lab.
P. Baccini, and T. Joller.
Schweizerische Zeitschrift fur Hydrologie, Vol 43, No 1, p 176-199, 1981. 18 Fig, 3 Tab, 19 Ref.

Descriptors: *Copper, *Zinc, *Lakes, Sedimentation, Eutrophic lakes, Meromictic lakes, Sedimentation rates, Heavy metals, Iron, Anaerobic conditions, Diffusion coefficient, Mathematical models.

Previous studies of the effects of heavy metal inputs on the ecology of aquatic systems have indicated that copper and zinc are the two elements whose tolerance limits should be lowered to prevent toxic effects on plankton communities in Swiss running waters. The residence time of copper and zinc in holomictic systems under aerobic conditions can be predicted if the production of biomass, the sedimentation rate, and the hydraulic properties of the lake are known. Lake Baldegg, a meromictic lake in central Switzerland, was selected for study of the effects of a permanent anaerobic hypolimnion on the transport of copper and zinc within the lake. An analysis of the seasonal variations of the dissolved and particulate concentrations of the two metals indicated that a significant quantity of particulate copper is formed in the hypolimnion. Zinc did not show a similar pattern. Analysis of the sedimentation rates at the lake bottom indicated that there is a distinct difference between copper and zinc in a period of high organic production and stagnation. While zinc correlates well with organic carbon, copper does not. Zinc was found to be more strongly assimilated into planktonic particles than was copper, with most of the particulate zinc reaching the sediment being of autochthonous origin. Copper, but not zinc, was also sorbed on iron particles formed in the upper hypolimnion at the Fe(3+)/Fe(2+) interface, leading to additional copper elimination by sedimentation. A flux scheme for the hypolimnic transport of copper, which was quantified in a one-dimensional diffusion model, was used to explain the observed variations of concentration profiles. (Carroll-FRC)
W82-05518

ELEVATED CONCENTRATIONS OF ACTINIDES IN MONO LAKE,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
R. F. Anderson, M. P. Bacon, and P. G. Brewer.
Science, Vol 216, No 4545, p 514-516, April 30, 1982. 2 Tab, 25 Ref.

Descriptors: *Radioisotopes, *Fate of pollutants, *Radioactive wastes, *Saline lakes, Thorium, Uranium radioisotopes, Plutonium, Protactinium, Lakes, Water pollution sources, Carbonates.

Tetravalent thorium (Th), pentavalent protactinium (Pa), hexavalent uranium (U), and plutonium (Pu) are present at higher concentrations in Mono Lake water than in seawater. Low ratios of actinium to Pa and americium to Pu suggested that the levels of trivalent actinides in the water column are not similarly enchanced. High levels of the ordinarily insoluble actinides are kept in solution by natural ligands such as carbonate ions or alkaline brines. This effect inhibits their chemical removal from the water column and has important implications for the management of radioactive wastes and their transport in groundwater. (Geiger-FRC)
W82-05520

A COMPUTER MODEL FOR HEAVY METAL TRANSPORT WITHIN THE PENOBSCOT RIVER,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. H. Fitch, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236589, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, May, 1979. 79 p, 1 Fig, 3 Tab, 23 Ref, 5 Append. OWRT A-037-ME(2).

Descriptors: *Heavy metals, *Mathematical models, *River flow, *Pollution load, *Water pollution, Pollutant identification, Computer models, Model studies, Computers, Mathematical studies, Mixing, Zones, Reach, River mechanics, Flow, Streamflow, River wash, Adsorption.

A three-component integrated mathematical model was developed and computerized for use in predicting heavy metal concentrations (dissolved and fixed) at locations downstream from a waste discharge to a river. The model was formulated using a step-wise approach which first simulates the mixing of a waste steam with a river flow, then simulates adsorption-desorption reactions, and finally simulates particulate transport. Mixing and adsorption-desorption reactions are assumed to occur in a mixing zone at the beginning of each river reach. The mixing zone output is considered to be stable with respect to metal speciation throughout the reach, and is used as input data to the particulate transport model to determine metal locations at any reach point. Use of the modified Einstein procedure afforded a description of particulate motion in the river. It was concluded that: river sediment motion is important for describing river heavy metal movement; interactions of ions, particulates, and other natural substances must be described to simulate heavy metal transfer within natural waters. In addition to predicting heavy metal concentrations at any given point, location of contamination areas may also be feasible. (Zielinski-MAXIMA)
W82-05544

ROLE OF SEDIMENT IN NON-POINT SOURCE SALT LOADING WITHIN THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. W. Shen, J. B. Laronne, E. D. Enck, G. Sunday, and K. K. Tanji.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236654, Price codes: A11 in paper copy, A01 in microfiche.

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Report No 107, August, 1981. 213 p, 81 Fig, 35 Tab, 39 Ref, 7 Append. OWRT B-137-COLO(1), OWRT B-170-COLO(5).

Descriptors: *Nonpoint pollution sources, *Sediment transport, *Simulation analysis, *Solute transport, *River basins, Pollution load, Sediments, Suspended load, Suspended solids, Sediment discharge, Tractive forces, Sediment-carrying capacity, Channel flow, Channeling, Slope degradation, Rills, Computer models, Model studies, Saltation, Catchment areas.

The role of sediment in diffuse-source salt loading in the upper Colorado River basin was investigated. The results proved that entrainment and transport of sediment by overland and channelized flow are crucial factors affecting the salinity of runoff from diffuse source areas. Increased concentration of transported sediment increases the availability of soluble minerals; further transported sediment may continue dissolving due to kinetic disequilibrium and/or when mixed with Colorado River water. Sediment yield increases during rilling with a contemporaneous increase in solute yield. Rills form faster and are undercut to a greater extent by direct runoff than by rainfall-induced runoff. The importance of rill flow to erosion and solute yield is so overwhelming that a computer simulation of rill pattern and its variation with hillslope inclination was developed. The most practical conclusion arising from the rilling effect is the indirect dependence of solute yield on hillslope inclination. Regression of solute yield on hillslope inclination. Regression of solute yield versus slope may be used as a reliable procedure to estimate solute yield under varying climatic conditions from diffuse source areas that are comparable in terms of their soluble mineral concentration and erodibility. Ionic derivatives of more soluble minerals are more common as sediment load increases. Recommendations for decreasing solute yields are provided. (Zielinski-MAXIMA)
W82-05551

THE SOCIO-ENVIRONMENTAL IMPACTS OF ENERGY DEVELOPMENT ON LOCAL USER GROUPS AND WATER RESOURCE PLANNING,
Washington State Univ., Pullman.
R. L. Wisniewski, and W. R. Freudenburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236670, Price codes: A07 in paper copy, A01 in microfiche. Report, October, 1981. 114 p, 7 Fig, 38 Tab, 60 Ref, 1 Append. OWRT A-106-WASH(1), 14-34-0001-1151.

Descriptors: *Nuclear powerplants, *Public opinion, *Public utility districts, *Surveys, *Electric power production, Fuel reprocessing, Powerplants, Nuclear reactors, Radioactive wastes, Attitudes, Public participation, Social participation, Construction, Nuclear energy, Environmental effects, Environmental protection, Regional development, Regional analysis, Urban planning.

Assessment was made of the soci-environmental impacts created by the Grays Harbor County twin nuclear power generating plants being constructed by the Washington Public Power Supply System (WPPSS), using a combination of methods. The methods included over 300 interviews concluded in the immediate vicinity of the plants, and another 300 in a comparison area of eastern Pacific County. Five major conclusions were reached: both Counties showed strong opposition to the power plants, and to nuclear power, in general; water quality issues appeared to be a major reason behind the opposition; Grays Harbor County residents appeared significantly more concerned about most sources of pollution than Pacific County residents; residents of the region may have a moderate tendency to underestimate their own contributions to existing water quality problems; and, residents in both counties evidenced relatively little awareness of water conservation possibilities. The results of this study implied that an energy facility builder's action can have significant consequences for local and regional public opinion, which, in turn, can have significant implications for the builder. Public opinion appears to have been strongly affected by a perceived lack of competence on the part of WPPSS and by the perception that WPPSS has failed to devote adequate consideration to local preferences. Public attitudes were not predictable on the basis of economic factors alone. (Aielinski-MAXIMA)
W82-05553

OIL AND GREASE IN STORMWATER RUNOFF,
California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 5C.
W82-05557

AGRICULTURAL RUNOFF AND WATER POLLUTION,
Department of the Environment, Victoria (British Columbia). Assessment and Planning Div.
J. H. Weins.
Canadian Water Resources Journal, Vol 5, No 3, p 78-89, 1980. 13 Ref.

Descriptors: *Agricultural runoff, *Nonpoint pollution sources, *Animal wastes, British Columbia, Water pollution sources, Agricultural wastes, Legislation, Regulations, Water pollution control, Farm management, Farm wastes, Nutrients, Sediments, Pesticides, Fertilizers, Feedlot runoff.

Livestock activities (dairy farms, beef feedlots, cattle overwintering areas, waste storage areas, and watering locations) are the most serious sources of agricultural runoff pollution to surface and groundwater in British Columbia. These activities raise levels of BOD, fecal coliforms, nitrogen, and phosphorus in watercourses and downstream lakes, especially during spring melt and rainfall events. Other nonpoint source pollutants--sediment, pesticides, and fertilizers--are less of a problem in this region. Several legislative acts regulate pollution from agricultural activities. The Agricultural Environmental Control program, organized in 1975, handles pollution complaints and promotes improvements in farm management practices. Essentially it is a combined regulatory and voluntary system. Some perceive this program as inadequate. Some measures to reduce pollution from agricultural sources include: education and extension programs, monitoring both on a regular basis and during special events (snowmelt, high and low flow), pilot improvement projects to investigate and demonstrate runoff control technologies, and review of present voluntary and regulatory measures. (Cassar-FRC)
W82-05569

HUMIC SUBSTANCES IN SEWAGE SLUDGES,
Catania Univ. (Italy). Inst. of Agricultural Chemistry.
For primary bibliographic entry see Field 5E.
W82-05576

A CASE STUDY OF NUTRIENTS IN THE RIVER HOLEM, WEST YORKSHIRE, ENGLAND,
Victoria Univ. of Manchester (England). Pollution Research Unit.
L. Brown, E. G. Bellinger, and J. P. Day.
Environmental Pollution, Series B, Vol 3, No 2, p 81-100, February, 1982. 4 Fig, 4 Tab, 44 Ref.

Descriptors: *Rivers, *Nutrients, Cycling nutrients, Orthophosphates, Phosphates, Nitrates, Ammonium, Nitrite, Seasonal variations, Water pollution effects.

This paper discusses the use of river concentration and mass flow data to suggest the possible nature of equilibrium processes which affect river nutrient concentrations. The concurrent analysis of biologically more stable ions was used to obtain some form of internal standardization for the nutrient assessment. The concentrations of orthophosphate, nitrate, ammonium, and nitrite were determined and found to demonstrate significant natural fluctuations dependent upon effects related to season and/or river flow. A mass flow balance suggests appreciable losses of both orthophosphate and ammonium following pollutant inputs. No comparable losses, other than that accountable for by tributary dilution, occurred for nitrate, nitrite or the various biologically stable ions studied concurrently to act as internal standards. (Baker-FRC)
W82-05577

COPPER POLLUTION STUDIES IN LAKES GEORGE AND EDWARD, UGANDA: THE DISTRIBUTION OF CU, CD AND FE IN THE WATER AND SEDIMENTS,
East African Freshwater Fisheries Research Organization, Jinja (Uganda).
F. W. B. Bugenyi.
Environmental Pollution, Series B, Vol 3, No 2, p 129-138, February, 1982. 2 Fig, 6 Tab, 10 Ref.

Descriptors: *Water pollution sources, *Lakes, Lake George, Lake Edward, Uganda, Copper, Cadmium, Iron, Sediments, Water quality, Path of pollutants, Lake sediments.

A program was initiated in East African lakes to obtain baseline information on the distribution of copper in the water body, the sediments and the biota and also on its toxic effects on the aquatic biota, particularly the Tilapia fish species, which form a major commercial fishery and food resource for the area. Nine sampling sites were established on the water system: River Nyamwamb-Lake George-Kazinga channel-Lake Edward. The distribution of copper, cadmium, and iron in the entire water system showed no major differences in the concentrations in the surface, mid-depth, and bottom waters. However, a gradual drop was noted in the concentrations in the sediments from Lake George to Lake Edward. The sediments act as natural sinks for a large fraction of the metal ions. The chemical oxygen demand, the ionic conductivity, and the volatile organic carbon results indicate that Lake George has higher COD and lower ionic conductivity values, whereas Lake Edward has higher COD and conductivity values. The indirect effect of this fact on the distribution of the heavy metals was noted. The higher concentrations of phosphates in Lake George ensure an abundance of algal blooms and thus higher turbidity. This leads to lower transparency values. The reverse is true for Lake Edward. Concentrations of copper, iron and cadmium appear likely to cause little environmental damage at the present time. (Baker-FRC)
W82-05578

QUANTITATIVE ASSESSMENT OF FILAMENTOUS ALGAE AS A SOURCE OF DETERIORATING WATER QUALITY IN CANALS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiyuk, F. V. Stol'berg, and V. N. Sotnikov.
Hydrobiological Journal, Vol 16, No 6, p 69-73, 1980. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Algae, *Biological oxygen demand, *Canals, Water pollution sources, Filamentous algae, Canal linings, N. Donets-Donbass Canal, Water quality, Organic matter, Cladophora, Spirogyra.

Data (962-76) on water discharge, flow rate, filamentous algal biomass, and BOD in the N. Donets-Donbass Canal, USSR, were analyzed to derive a quantitative picture of the role of filamentous algae in water pollution. In lined canals these algae increased BOD by hyperproduction of organic matter. In 1968 algae produced BOD equivalent to 46,000 g oxygen per 100 km of canal length, corresponding to the effluents of a city with 200,000 to 300,000 population. An equation is given to calculate the input of organic matter and increase of BOD in the canal water from cross sectional area, canal length, flow velocity, and canal discharge. Mean annual indices should be used to counteract the variations caused by temperature and life cycles of the algae. (Cassar-FRC)
W82-05593

EFFECT OF SEWAGE EFFLUENT ON THE SEDIMENTS OF NORDASVATNET (A LAND-LOCKED FJORD), NORWAY,

Alexandria Univ. (Egypt). Dept. of Oceanography.
M. K. El-Sayed.
Marine Pollution Bulletin, Vol 13, No 3, p 85-88, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater disposal, *Sediments, *Metals, Fate of pollutants, Water pollution sources, Fjords, Heavy metals, Organic matter, Anaerobic conditions, Iron, Manganese, Copper, Zinc, Bottom sediments, Carbonates.

Sediments from the anoxic Nordasvatnet fjord, Norway, which receives 8000 cu meters per day of untreated domestic sewage, were analyzed. Concentrations of metals and other constituents were: total iron, 2.53-5.75%, average 4.2%; manganese, 300-1400 ppm, average 565 ppm; copper, 20-125 ppm, average 41.2 ppm; zinc, 72-427 ppm, average 209.5 ppm; carbonate, 1.2-12.2%, average 7.6%; and organic carbon, 2.5-12.5%, average 9.97%. Concentrations of heavy metals were highest in the upper layers of the core samples; carbonate levels increased from the srface to the deeper levels. (Cassar-FRC)
W82-05605

AN APPROXIMATE PETROLEUM HYDROCARBON BUDGET FOR THE HUDSON RARITAN ESTUARY--NEW YORK,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Connell.
Marine Pollution Bulletin, Vol 13, No 3, p 89-93, 1982. 1 Fig, 2 Tab, 29 Ref.

Descriptors: *Oil pollution, *Sediments, *Industrial wastes, Oil spills, Path of pollutants, Fate of pollutants, Water pollution sources, Hudson River, Raritan River, Estuaries, New York Bight, New York, Polyaromatic hydrocarbons, Runoff, Wastewater pollution, Dredging, Evaporation, Organic compounds.

A petroleum budget for the Hudson Raritan Estuary, New York, estimated from published literature, accounted for an input of 92 tons per day and losses of 70 tons per day. Inputs (in tons per day) were: sewage discharges, 35; oil refinery discharges, 1.3; non-oil refinery industrial discharges, 17; oil spills, 1.5; atmospheric deposition, 0.002; urban and rural runoff, 37. Losses (in tons per day) were: permanent deposition in sediments, 11; dredging, 5.8; advection, 6.5; bed sedimentary transport, 0.007; decomposition in water and sediments, 42; evaporation, 0.4; movement of surface slicks, 0.4. (Cassar-FRC)
W82-05606

FECAL COLIFORM DENSITIES IN A WESTERN WATERSHED,
Black and Veatch, Denver, CO.
P. J. Psaris, and D. W. Hendricks.
Water, Air, and Soil Pollution, Vol 17, No 3, p 253-262, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Coliforms, *Bacteria, *Irrigation water, Path of pollutants, South Platte River, Colorado, Water quality standards, Wastewater disposal.

Fecal coliforms concentration data (EPA STORET records, 1980) from 99 sampling stations throughout the South Platte River system, Colorado, were analyzed. Coliform densities were 0-99 organisms per 100 ml in mountain streams and 10,000-100,000 organisms per 100 ml or higher in plains streams. The source of coliforms is wastewater discharged by municipalities into the river system or into land disposal areas. Colorado Departmet of Health standards (200 fecal coliforms per 100 ml for Recreation Class I, 1000 for irrigation water, and 2000 for Recreation Class 2 and Drinking Water Supply Class 2) were exceeded by 33-53% of stations overall, depending on use, by 3-12% of mountain stations, and by 50-75% of plains stations. Water from this river system is widely spread during irrigation. The current policies encouraging land treatment and reuse of wastewater should be reviewd with respect to compliance with proposed fecal coliform standards. (Cassar-FRC)
W82-05618

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT, I. RESIDUES OF ORGANOCHLORINE PESTICIDES,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, M. M. A. Elamayem, A. H. El-Sebae, and I. F. Sharaf.
Water, Air, and Soil Pollution, Vol 17, No 3, p 245-252, 1981. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Fish, *Water analysis, *Pesticides, Fate of pollutants, Saline lakes, Accumulation, Lake Mariut, Egypt, Insecticides, Lakes, DDT, Lindane, Chlorinated hydrocarbons, Pollutant identification.

Water and fish from the brackish coastal Lake Mariut, Egypt, were analyzed for organochlorine pesticides at monthly intervals from August 1978 to July 1979. The lake has been severly polluted by human, industrial, and agricultural wastes. Mean concentrations of several pesticides (in ppb) were: lindane, 2.09; p,p'-DDE, 4.49; o,p'-DDT, 0.01; p,p'-DDT, 0.13; and total DDT, 5.1. DDT levels were highest (about 10 ppb) in January-March with a secondary peak (8 ppb) in October. Lindane levels were highest in October (8 ppb) and lowest in November-February. In Tilapia fish the mean concentrations (in ppb) of pesticides were: lindane, 35.0; p,p'-DDE, 39.0; p,p'-DDT, 17.4; and total DDT, 60.8. Higher pesticide concentrations in the southern part of the lake reflected input of drainage waters. (Cassar-FRC)
W82-05620

DETERMINATION OF RECENT DESPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS,
Heidelberg Univ. (Germany, F. R.). Lab. for Sedimentology.
J. Dominik, A. Mangini, and G. Muller.
Sedimentology, Vol 28, No 5, p 653-677, October, 1981. 10 Fig, 11 Tab, 54 Ref.

Descriptors: *Sedimentation rates, *Radioisotopes, *Lead radioisotopes, *Deposition(Sediments), Lead, Zinc, *Lake Constance, Radioactive dating, Dating, Cesium radioisotopes, Heavy metals, Metals, Fate of pollutants, Lakes, Nutrients, Sedimentology, *Lake sediments.

Sedimentation rates were determined with the Pb-210 method in eight sediment cores from Lake Constance. The rate of deposition in the main basin (Obersee) varies from about O.06 g/sq cm/y in the central part to 0.13 g/sq cm/y in the eastern part of the lake and then increases rapidly towards the Rhine delta. In the central lake area the rate of deposition has been approximately constant since 1900, and dating with the Pb-210 method is in good agreement with sedimentological observations. In the Konstanzer Trichter area, the deposition rate has been increasing since about 1955 as a result of eutrophication and subsequent high carbonate production. Dating with Cs-137 is fairly accurate for sediments deposited at a high rate, but is questionable for slowly accumulating ones. A positive correlation of Pb-210 fluxes and sedimentation rates indicates that Pb-210 flux into sediments follows the distribution pattern of solids. Pb-210 profiles in four sediment cores interpreted in terms of a constant flux model display synchronous fluctuation of the sedimentation rate; however, their relation to long-range particulate input variations remains to be proved. Sedimentation rates determined with the Pb-210 method were used to calculate recent nutrient and heavy metal fluxes. Anthropogenic fluxes of Zn and Pb are in the same range of magnitude as in other polluted areas in Europe and America. (Author abstract)
W82-05625

CONTAMINANT DISPERSION IN OSCILLATORY FLOWS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol 114, p 379-398, 1982. 7 Fig, 19 Ref.

Descriptors: *Contamination, *Flow profile, Oscillatory waves, Waves, Mathematical equations, Model studies, *Estuaries, Estuarine environment, *Path of pollutants.

A substantial time span can occur in which a cloud of a contaminant is contracting after each flow reversal in an oscillatory system if the time scale for cross-sectional mixing is comparable with or larger than the flow period. Thus the apparent longitudinal diffusion coefficient in such systems, including many major tidal waterways, is negative. The contaminant dispersion therefore cannot be modeled by a diffusion equation, since negative diffusivities imply the spontaneous development of infinite concentrations. The manner in which this periodic contracting and expanding can be modeled by a delay diffusion equation is demonstrated, using the bulk velocity, a coordinate displacement and the diffision coefficient at a specific time after discharge. The recent memory is always positive and diffusive in character, so singularities cannot arise. However, when the time after discharge is large, this memory function can be negative due to reversed flow at earlier times. Particular attention is given to estuarine flows, and results are derived for the dependence of the diffusion coefficient on the water depth and on the width of the estuary. (Baker-FRC)
W82-05631

ORGANOCHLORINE RESIDUES IN SUSPENDED SOLIDS COLLECTED FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES 1974-1977,
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, R. L. Thomas, H. Holdrinet, R. K. McMillan, and H. E. Braun.
Journal of Great Lakes Research, Vol 7, No 4, p 363-381, 1981. 2 Fig, 13 Tab, 13 Ref.

Descriptors: *Suspended solids, *Pollutant identification, Sedimentation, *Organophosphorus pesticides, *Great Lakes, Organic compounds, Pesticides, *Canada, Water pollution sources, Land drainage, Path of pollutants.

A study was conducted to determine whether and how the boundary waters of the Great Lakes are being polluted by land drainage. Between 1974 and 1977, 186 samples of suspended solids were collected from 105 stream mouths out of 176 streams draining the Canadian shoreline of the Great Lakes basin. The widespread use of DDT between 1947 and 1971 was reflected in the presence of DDT and its metabolites in suspended solids of all 105 streams sampled. HEOD was detected in 15 of the 43 suspended solid samples collected, with the highest mean residues occurring in streams draining into Lake Ontario along the southwest shoreline. Endosulfan was present in five of the eleven streams draining into Lake Ontario along the southwestern shoreline. Endrin was noted in 30 Mile Creek at 4 micrograms/kg. No residues of chlordane and HE were detected in 1974 samples. During the study period, about 70% of the total insecticides used by Ontario agriculture were applied in the Lake Erie watershed, 14% each in the Lake Ontario and St. Clair watersheds and 2% in the Lake Huron watershed. No aldrin, endrin mirex, heptachlor or organophosphorus insecticides were detected. (Baker-FRC)
W82-05635

ORGANIC CONTAMINANTS IN THE SUSPENDED SEDIMENTS OF THE NIAGARA RIVER,
Canada Centre for Inland Waters, Burlington (Ontario).
N. D. Warry, and C. H. Chan.
Journal of Great Lakes Research, Vol 7, No 4, p 394-403, 1981. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Suspended sediments, *Organic chemicals, Pesticides, Great Lakes, *Lake Ontario, *Niagara River, Rivers, Sediment transport, Water pollution sources, DDT, Dieldrin, Lindane, Heptachlor epoxide, Chemical analysis, Organic wastes, *Pollutant identification.

A suspended sediment sampling program was initiated in the lower Niagara River during 1978 to

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determine quantitatively the presence of organic contaminant residues in the suspended sediments of the Niagara River. This report covers results obtained from April 26, 1979, through April 22, 1980. The suspended sediments provided a continuing source of PCBs and other pesticide residues to Lake Ontario. The loadings are ranked in decreasing order of concentration as PCB, DDT, mirex, chlordane, methoxychlor and endosulfan. The concentrations of all these residues are quite variable with time, with concentration changes up to a factor of 3 not being unusual within a month. The available evidence suggests that active sources of some contaminants are located along the Niagara River downstream from Grand Island. The 1979 loading of total PCBs to Lake Ontario from the Niagara River is 2.7 times the total PCB loading to the whole lake as calculated for 1968, while DDT and mirex loading from the Niagara River in 1979 are less than the 1968 loadings. The most surprising result is that the loading of mirex to Lake Ontario is continuing in spite of the fact that the primary source, Hooker Chemical, no longer produces the pesticide. Other pesticides sought included lindane, dieldrin, endrin, heptachlor, heptachlor epoxide, and aldrin. Of these, only lindane, dieldrin, and heptachlor epoxide were ever detected. (Baker-FRC)
W82-05636

WATER QUALITY MODELING OF LAKE MICHIGAN AND CONSIDERATION OF THE ANOMALOUS ICE COVER OF 1976-1977,
Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
P. Rodgers, and D. Salisbury.
Journal of Great Lakes Research, Vol 7, No 4, p 467-480, 1981. 10 Fig, 3 Tab, 43 Ref.

Descriptors: Water quality, *Model studies, Lakes, *Lake Michigan, Great Lakes, *Ice cover, *Phosphorus, Phytoplankton, *Load distribution, *Path of pollutants.

The concurrent effects of a phosphorus load reduction in 1977 and a climatically induced ice cover are examined via a phytoplankton simulation model for their relative importance in affecting an observed phosphorus depletion. The application of ecological models to the Lake Michigan basin was the central focus of this research. A modified version of a deterministic phytoplankton mode, Lake 1 by Thomann, was first calibrated to the 1976 Lake Michigan field data. A dynamic phytoplankton simulation model (MICHI) was developed to investigate the observed field data and to use in forecasting lake responses to various phosphorus loading scenarios. The 1977 data indicated that the southern basin of Lake Michigan lost up to 3 micrograms of phosphorus per liter compared to concentrations observed in 1976. In an attempt to simulate this rapid depletion of phosphorus, MICHI required an implicit representation of suspected effects of an extensive ice cover observed during the winter of 1976-77. This included increasing the net apparent settling rate eight fold during ice cover. A total phosphorus model was used in conjunction with MICHI for forecasting. These forecasts indicate a steady-state total phosphorus concentration of 7 micrograms phosphorus per liter, given the target load recommended by the 1978 Water Quality Agreement. The projected time to obtain 95% of steady-state response to a load change was 7-14 years. (Baker-FRC)
W82-05638

GEOCHEMICAL PATHWAY STUDIES OF HEAVY METALS IN LAKE SEDIMENTS FROM THE SUDBURY-TEMAGAMI AREA, ONTARIO,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. H. Crocket, and A. Kabir.
Journal of Great Lakes Research, Vol 7, No 4, p 455-466, 1981, 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Heavy metals, Water pollution sources, Lakes, Industrial lproduction, Fallout, Lead, Nickel, Palladiu,, Gold, Selenium, Copper, Iridium, Neutrom activation analysis, *Lake sediments, *Path of pollutants, atomic absorption, x-ray fluorescence, Canada (Ontario).

Radiochemical neutron activation, atomic absorption, and x-ray fluorescence were used to determine the concentrations of some heavy metals in lake sediments from the Sudbury-Temagami area. Dredge samples were taken from 23 lakes, usually from the deepest part. The study area contains a major world source of nickel and an important producer of copper and other heavy metal byproducts, including the noble metal group. Major nickel and copper minerals of the Sudbury area are pentlandite, pyrrhotite, and chalcopyrite. Concentration gradients for lead, arsenic, and selenium tend to center about the Sudbury industrial complex and increse toward it. Metal concentration profiles over the top 20 cm of sediment core samples from five lakes show pronounced increases in lead, iridium, gold, arsenic, selenium, copper, nickel, and palladium in the top 5 cm. These data suggest that one of the principal routes for heavy metal loading of lake sediments in the area is atmospheric fallout of particulate material. (Baker-FRC).
W82-05640

PESTICIDES AND PCB IN THE GRAND AND SAUGEEN RIVER BASINS,
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank.
Journal of Great Lakes Research, Vol 7, No 4, p 440-454, 1981. 1 Fig, 12 Tab, 34 Ref.

Descriptors: *Polychlorinated biphenyls, *Pesticides, River basins, Catchment areas, Land use, Rivers, Basins, Suspended solids, Great Lakes, *Non-Point sources, Dieldrin, Chlordane, Atrazine, Simazine, *Agricultural chemicals, DDT, Water pollution sources, Agricultural runoff.

This paper forms part of an overall study into pollutant losses from diffuse sources due to land use activities, adding information on pesticides and PCBs to the information base being established. Attempts were made to integrate crop distribution and pesticide use information in order to develop a better understanding of the dispersal of pesticides in two major river systems. The Grand and Saugeen rivers drain two major basins in the Ontario Province of Canada, and discharges into Lake Erie and Lake Huron respectively pesticides were classified as persistent or non-persistent. Members of both categories appeared in upstream waters; however, only the former appeared at the river mouths. Non-persistent pesticides found in the system occurred at the time of spraying or shortly thereafter in storm runoff waters but not at other times. Persistent pesticides found in the system included those that had been discontinued and those in use throughout the study period. Dieldrin, DDT, chlordane, atrazine, and simazine were identified in water or on suspended solids throughout the year. Atrazine was the most widely used pesticide in the basins, and loadings at the mouth appeared to be 0.6% of that applied. Loadings of chlordane and heptachlor epoxide at the mouth suggest that greater inputs were coming from urban uses. PCB was ubiquitious in the two basins, and losses as measured at the river mouths were on the order of 30-40- and 7-10 kg/year for the Grand River and Saugeen River watersheds, respectively. No residues of mirex were detected in either system. (Baker-FRC)
W82-05641

TRANSPORT OF NITRATE AND GASEOUS DENITRIFICATION IN SOIL COLUMNS DURING LEACHING,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, H. P. Johnson, and D. Kirkham.
Journal of Hydrology, Vol 55, No 1/4, p 171-184, 1982. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrates, *Solute transport, Fate of pollutants, Nitrogen compounds, Denitrification, Fertilizers, Leaching, Soil columns.

Nitrate leaching (considered a first-order reaction) in a soil column of finite length was theoretically analyzed. Transport equations and boundary conditions describing nitrate movement and denitrification in soil were solved for continuous application of nitrate at the soil surface. The relative concentration profiles of nitrate movement were obtained for any time and for known values of the diffusion coefficient and average solute velocity. Laboratory experimental data reported in the literature supported the validity of the model. In field conditions an aquifer with moving water would act as a sink. This model is useful in determining the optimum application of fertilizers to agricultural land in order to avoid nitrogen accumulation in the soil or water contamination. (Cassar-FRC)
W82-05709

EFFECTS OF SELECTED ORGANIC COMPOUNDS ON RADIONUCLIDE ADSORPTION TO SEDIMENTS IN FRESHWATER SYSTEMS,
Washington Univ., Seattle. Coll. of Ocean and Fisheries Sciences.
For primary bibliographic entry see Field 5C.
W82-05724

METHOXYCHLOR RESIDUES IN TREATED IRRIGATION CANAL WATER IN SOUTHCENTRAL IDAHO,
Idaho Univ., Moscow. Twin Falls Cooperative Extension Service.
R. L. Stoltz, and G. A. Pollock.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 473-476, 1982. 2 Fig, 6 Ref.

Descriptors: *Insecticides, *Canals, *Methoxychlor, Pesticides, Twin Falls, Idaho, Fate of pollutants, Snake River.

Methoxychlor, an insecticide used to control black fly larvae in water bodies, reached peak levels of 1.4 ppb, 0.4% of initial concentration (0.3 ppm), during application to a canal system. The water was treated 12 times during the summer of 1980 at Murtaugh Lake on the Twin Falls canal system, Idaho. Samples for residue analysis were taken 42-45 hours after four of the applications at a distance 75 miles downstream before the canal enters the Snake River. Low levels of methoxychlor (0.14 ppb) were present 70 hours after the August applications. All measured methoxychlor levels were far below the 52 ppb LC50 for rainbow trout. (Cassar-FRC)
W82-05726

INDICATIONS OF GROUND WATER INFLUENCES ON NUTRIENT TRANSPORT THROUGH SCHWATKA LAKE, YUKON TERRITORY,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
P. H. Whitfield, B. McNaughton, and W. G. Whitley.
Water Resources Bulletin, Vol 18, No 2, p 197-202, April, 1982. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Nutrients, *Solute transport, *Infiltration water, Groundwater movement, *Canada, Schwatka Lake, Yukon Territory, Phosphorus, Nitrates, Lakes, Nitrites, Nitrogen, Silicates, Carbon, Inorganic carbon, Organic carbon.

Nutrient budgets were estimated for Schwatka Lake, Yukon Territory, formed by the Whitehorse Rapids Dam, by analyzing water samples collected upstream and downstream of the lake. Exports of nutrients, expressed as % of input, were: total P, 17.0; nitrate and nitrite, 19.8; total N, 5.0; silicate, 1.2; inorganic C, 0.1; and organic C, 10.3. The most likely reason for these differences is groundwater contribtions to the lake. A probable source is the wastewater from the White Horse Copper Mines, and a probable route is via the large deposit of unconsolidated material underlying the reservoir. Other processes not considered influential in this particular case are evaporation from the impoundment, land surface drainage, bank erosion, and channel scouring. (Cassar-FRC)
W82-05741

SELECTING A METHOD FOR ESTIMATING SUBSTANCE LOADINGS,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
P. H. Whitfield.
Water Resources Bulletin, Vol 18, No 2, p 203-210, April, 1982. 5 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Solute transport, *Nutrients, *Statistical analysis, Schwatka Lake, *Canada, Yukon Territory, Phosphorus, Nitrates, Nitrites, Nitrogen, Silicates, Inorganic carbon, Organic carbon, Carbon, Lakes.

Four methods for estimating mass transport are evaluated using data on nutrient concentrations of waters flowing into and out of Schwatka Lake, Yukon Territory. The four methods are permutations of arithmetic vs. logarithmic normal distributions and independence vs. dependence on discharge. Method A is based on the assumption that concentration data has a unimodal normal distribution and that concentration is independent of discharge. Method B assumes that the logarithmic transfer of the concentration data is unimodal normal and that concentration is independent of discharge. Method C assumes that concentration is unimodal normal and dependent on discharge. Method D assumes that the logarithm of concentration is normally distributed and dependent on the logarithm of discharge. The most precise mass transport estimates were obtained using Method B. Method A overestimated the loadings. Methods C and D were within plus or minus 5% of Method B results in some cases but were inconsistent. (Cassar-FRC)
W82-05746

SOLUBLE MINERAL CONTENT IN SURFICIAL ALLUVIUM AND ASSOCIATED MANCOS SHALE,
Ben-Gurion Univ. of the Negev, Beer-Sheba (Israel). Dept. of Geography.
For primary bibliographic entry see Field 3B.
W82-05751

PHYSICOCHEMISTRY OF WATER IN THE ST. LAWRENCE GULF AND ESTUARY (PHYSICO-CHIMIE DES EAUX DU GOLFE ET DE L' ESTUAIRE SAINT-LAURENT),
Quebec Univ., Rimouski. Inst. National de la Recherche Scientifique.
D. Couillard.
Canadian Water Resources Journal, Vol 5, No 4, p 55-81, 1980. 9 Fig, 9 Tab, 31 Ref.

Descriptors: *Physicochemical properties, *Water quality, Reviews, *St. Lawrence Estuary, *Canada, Quebec, Dissolved oxygen, Water circulation, Salinity, Metals, Estuaries, Mercury, Fish, Suspended sediments, Water pollution sources.

The physicochemical properties of water in the St. Lawrence Gulf (east of Pointe-des-Monts) and Estuary (Quebec City to Pointe-des-Monts) is reviewed. General water circulation, salinity, bathymetry, and river discharges are depicted. Dissolved oxygen in the gulf varies from 1.8 ml per liter in the deep strata to 8 ml per liter in the surface water layer. The minimum oxygen concentrations are found in a 300-370 m deep area located between the Isle d'Anticosti and Newfoundland. pH of water is 8.0 at the surface and 7.6 in deeper water. Sediment pH is 6.9-8.1. Suspended sediments rarely exceed 1 mg per liter. Metals concentrations are generally low. Concentrations determined in one study were (in micrograms per liter): Zn, 10.2; Ni, 4.6; Cu, 4.5; Mn, 2.5; Pb, 2.3; and Cd, V, Mo, and Co all less than 0.4. Mercury levels in fish varied from 0.76 to 1.85 ppm. (Cassar-FRC)
W82-05763

SNOW CONTAMINATION BY HEAVY METALS AND SULPHUR IN CRACOW AGGLOMERATION (SOUTHERN POLAND),
Academy of Mining and Metallurgy, Kracow (Poland). Inst. of Environmental Protection.
P. K. Zajac, and K. Grodzinska.
Water, Air, and Soil Pollution, Vol 17, No 3, p 269-280, 1982. 5 Fig, 9 Tab, 23 Ref.

Descriptors: *Snow, *Steel industry, *Air pollution, Precipitation, Path of pollutants, Sulfates, Heavy metals, Metals, Acid rain, Sulfur compounds, Cracow, *Poland, Water pollution sources.

Samples of snow were collected on 3 dates in 1977 and 1978 at 27 sites in open and forest stands east of the large steel mill at Cracow, Poland. Concentrations of heavy metals, light metals, and sulfate decreased with increasing distance from the source, but snow acidity increased. There was considerable variation in pollutant concentrations in snow between sites, sample sets, type of forest, and open vs. cleared areas. Average metal concentrations (in mg per liter) were: Cd, 0.29; Pb, 3.1; Zn, 8.7; Fe, 923; Mg, 78; and Ca, 325. The mean sulfate ion concentration was 17.25 mg per liter. Snow pH varied from 10 at the source to 5 at a distance of 25 km. (Cassar-FRC)
W82-05783

GROUND-WATER CONTAMINATION DUE TO VANISHING AND FINITE-SIZE CONTINUOUS SOURCES,
Dames and Moore, Golden, CO.
A. Prakash.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 572-590, April, 1982. 10 Fig, 1 Tab, 27 Ref.

Descriptors: *Groundwater, *Water pollution sources, Contamination, Aquifers, Model studies, Mathematical equations, Leaching.

This paper presents simple analytical models to predict the spatial distribution of steady-state concentrations caused by continuous release of contaminants from a point, line, rectangular, or parallelepiped source in a groundwater environment with one- or two-dimensional uniform flow. This formulation includes the contributions of radioactive decay and soil adsorption, and the solutions can be used to approximate transports through stream-aquifer systems and through confined or unconfined aquifers. The results of the analytical model are compared with those of a finite-element study. The analytical model is simple, requires smaller computer time, and is free from convergence and stability problems associated with some numerical models. It is expected that the methods as presented would provide reasonably accurate results for many field situations. Examples are included to illustrate the effect of source configuration, for example point, line or plane, and the presence or absence of a fully penetrating perennial stream in the flowfield. To validate the model, concentration isopleths are developed for the release of effluents from an ashpond in a two-dimensional stream aquifer system. (Baker-FRC)
W82-05799

OCCURRENCE OF ENDOTOXINS IN GROUNDWATER DURING THE LAND APPLICATION OF WASTEWATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
S. M. Goyal, and C. P. Gerba.
Journal of Environmental Science and Health, Part A, Vol 17, No 2, p 187-196, 1982. 2 Tab, 10 Ref.

Descriptors: *Groundwater pollution, *Toxins, *Land application, Wastewater disposal, Endotoxins, Bacteria, Algae, Fate of pollutants.

Algal or bacterial endotoxin concentrations were 0.3 to 480 ng per ml in groundwater from wells 3 to 37 m beneath five sewage land application sites in Texas, Michigan, Arizona, and Massachusetts. Concentrations in wastewater samples were 300-6000 ng per ml. The groundwaters with the highest endotoxin levels were found at the sites with the highest endotoxin levels in the applied sewage effluents. Although endotoxin removal in the soil was 90-99.9%, levels were still higher than in most drinking waters (1.25-12.5 ng per ml). Most groundwaters have low or nondetectable levels of endotoxins. The possibility of using endotoxins as indicators of sewage water infiltration was suggested. (Cassar-FRC)
W82-05810

DILUTION OF MUNICIPAL LANDFILL LEACHATE, FRANKLIN COUNTY, INDIANA,
Ball State Univ., Muncie, IN. Dept. of Natural Resources.
P. J. Sullivan, and W. L. Morgan.
Journal of Environmental Health, Vol 44, No 5, p 253-257, March-April, 1982. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Leachates, *Landfills, Groundwater, Groundwater pollution, Leaching, *Indiana, Sanitary landfills, Waste dumps, Water quality, Rivers, Surface water.

This study was initiated to identify the possible source for contamination of local water resources in Franklin County, Indiana. In this county the sanitary landfill is located in an abandoned gravel pit and has been placed on a mandated phase-out schedule by the Land Pollution Control Division due to its poor geologic location and the absence of adequate leachate control. Soil textures of the daily cover at the landfill range from a sandy loam to a loam. This results in the rapid infiltration of rainfall. Groundwater monitoring wells were installed at several sites, and soil cores were taken. The Whitewater River was sampled upstream and downstream of the landfill as well. The soil coring data clearly demonstrated the lack of an impervious liner to the landfill. Areas south and east of the landfill will allow the movement of the leachate. The clay materials to the west will also force most groundwater flows away from the landfill to the south and southeast. No apparent change was noted in water quality within the Whitewater River. Only low concentrations of trace metals were found in the surface and groundwaters, perhaps due to the formation of insoluble metal complexes as a consequence of alkaline surface and groundwater. The fact that all the non-metal leachate parameters usually fall well below US EPA criteria may indicate that dilution of leachate is occurring. Iron concentrations slightly exceeded these same criteria. Existing groundwater conditions suggest a high volume and rapid movement of water within the aquifer. (Baker-FRC)
W82-05811

MODELS OF LANDFILL LEACHING: ORGANIC STRENGTH,
Wright-Pierce Architects/Engineers, Portsmouth, NH.
W. A. Straub, and D. R. Lynch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 251-268, April, 1982. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Landfills, *Leachates, Model studies, Mathematical equations, Infiltration, Percolation, Wastewater disposal, Sanitary landfill, Groundwater pollution, Waste disposal, Waste dumps.

To estimate groundwater pollution potential, mathematical models of moisture movement and inorganic leachate strength which had been applied using analysis of compacted solid waste as an unsaturated porous medium were extended to describe leachate organic strength, microbial activity and gas production. The roles of aerobic and anaerobic bacteria were simulated using conventional kinetic formulations. Computer simulations were obtained for landfill experiments reported by others, and good agreement with observed behavior was demonstrated. The models proved useful in describing organic leachate strength and landfill stabilization. Specific conclusions indicated that convective removal and anaerobic microbial activity dominate leachate organic strength and landfill stabilization. Convective effects may be dominant in some cases. Aerobic activity is relatively unimportant in determining the long-term quality of leachate when external air is not supplied to the landfill. Anaerobic activity was noted to occur in the landfill at a rate inhibited from ideal rates. The Monod kinetic model is useful in preliminary descriptions of anaerobic activity and indicates inhibition within the landfill. A microbial kinetic model may be useful in estimating landfill gas production. Finally, the retention of cells within the landfill system during recirculation of leachate may be a primary contributor to the accelerated

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organic stabilization typical of such systems. (Baker-FRC)
W82-05817

MODELS OF LANDFILL LEACHING: MOISTURE FLOW AND INORGANIC STRENGTH,
Wright-Pierce Architects/Engineers, Portsmouth, NH.
W. A. Straub, and D. R. Lynch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 231-250, April, 1982. 14 Fig, 33 Ref.

Descriptors: *Leachates, *Model studies, Landfills, Waste disposal, Mathematical studies, Infiltration, Percolation, Waste dumps, Sanitary landfills, Wastewater disposal, Groundwater pollution.

The literature concerning both empirical investigations and modeling of leachate production are reviewed, and models are developed which simulate landfill moisture movement and the inorganic contaminant strength of leachate. The models are used to simulate leachate behavior from experimental landfills documented by other investigators in order to illustrate their analytical potential. The study demonstrated the feasibility of analyzing compacted solid waste as an unsaturated porous medium. The advantage of this analytical approach lies in its process orientation - leachate quantity and quality result from the interaction of fundamental transport phenomena within specific physical and environmental settings. At present, leachate models are appropriate primarily for research purposes, insofar as they provide organized analytical structures for the design and interpretation of experiments. Simulations obtained with preliminary, aggregate representations of major hydraulic and contaminant transport processes are in overall agreement with leachate data documented in separate studies. Additional experimental work is needed identify and refine the description of basic processes occurring in the landfill environment. Ultimately, porous medium-based landfill models could be applied to field scale problems, although it must be noted that such applications would require extensive empirical support. (Baker-FRC)
W82-05818

TOTAL SUSPENDED SOLIDS IN HIGHWAY RUNOFF IN WASHINGTON STATE,
RH2 Engineering, Seattle, WA.
R. Asplund, B. W. Mar, and J. F. Ferguson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 391-404, April, 1982. 3 Fig, 6 Tab, 37 Ref.

Descriptors: *Suspended solids, *Runoff, Highways, Roads, Rainfall, Rainfall-runoff relationships, Water pollution sources, *Washington.

A characterization of total suspended solids (TSS) found in highway storm water runoff was based on the first year of continuous statewide monitoring at nine sites in the state of Washington. The major topics explored included a comparison of the data collected from this project with previously published data, a determination of trends in the data which may support the development of a model, and a determination of the major sources of storm water runoff TSS and parameters which may influence TSS deposition and removal from the highway. During this year a total of 241 storms were sampled with a composite sampling system. Vehicle traffic during the storm was found to be the principal factor influencing the mass of suspended solids in the runoff. During winter ice conditions a major fraction of solids loadings in runoff could be traced to sand use. A predictive model for total suspended solids loadings was derived as a function of cumulative traffic during the storms. Traffic during the dry periods appeared to remove pollutants from the highway and is not significant in predicting pollutant loadings in the state of Washington. (Baker-FRC)
W82-05820

HYDROLOGY OF AREA 3, EASTERN COAL PROVINCE, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05831

HYDROLOGY OF AREA 25, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05832

HYDROLOGY OF AREA 4, EASTERN COAL PROVINCE, PENNSYLVANIA, OHIO, AND WEST VIRGINIA,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05833

HYDROLOGY OF AREA 5, EASTERN COAL PROVINCE, PENNSYLVANIA, MARYLAND, AND WEST VIRGINIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05834

QUALITY OF WATER IN JAMES CREEK, MONROE COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1181, 1981. 28 p, 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, *Mississippi, Monroe County, James Creek.

A short-term quality-of-water study of James Creek near Aberdeen, Mississippi was conducted on November 14-16, 1978, during a period of low streamflow. During the study, the water in the 2.6-mile stream reach was undesireable for many uses. Wastewater inflow immediately upstream of the study area contributed to the dissolved-solids load in James Creek. The specific conductance of the water ranged from 775 to 890 micromhos at the head of the study reach and from 650 to 750 micromhos at the end of the study reach. A substantial biochemical oxygen-demand was evident in James Creek. Five-day biochemical oxygen demand values downstream of a sewage disposal pond outfall ranged from 8.3 to 11 milligrams per liter and dissolved-oxygen concentrations ranged from 0.4 to 4.5 milligrams per liter. Nitrogen and phosphorus compounds and fecal bacteria densities were highest downstream. Total ammonia nitrogen and phosphorus concentrations in the water leaving the study area ranged from 0.29 to 1.4 milligrams per liter and from 0.65 to 1.7 milligrams per liter, respectively. Fecal coliform densities exceeding 50,000 colonies per 100 milliliters of sample were observed in the study area. The median fecal coliform density of the water leaving the study area was 2,800 colonies per 100 milliliters. (USGS)
W82-05842

AN EVALUATION OF THE EFFECTS OF ACID RAIN ON LOW CONDUCTIVITY HEADWATER STREAMS IN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
J. R. Ritter, and A. E. Brown.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $7.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1025, September 1981. 53 p, 10 Fig, 5 Tab, 7 Ref.

Descriptors: *Acid rain, *Water quality, *Comparison studies, *Streams, Low flow, Data collections, Water analysis, Chemical reactions, Alkalinity, Hydrogen ion concentration, Conductivity, Sulfates, *Pennsylvania, Delaware River basin, Susquehanna River basin, Ohio River basin.

Analyses of water collected at 32 sites on headwater streams in Pennsylvania during low-flow conditions in 1979-80 were compared to pre-1971 data to evaluate whether acid rain had changed the chemistry of the streams in the previous decade. Most pH, alkalinity, and sulfate values of the samples collected in 1979-80 fell within the ranges of values for samples collected before 1971. The limited data indicate, however, that pH may have increased and alkalinity and sulfate may have decreased with time. (USGS)
W82-05843

QUALITY OF WATER AND TIME OF TRAVEL IN GOODWATER AND OKATOMA CREEKS NEAR MAGEE, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $5.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1012, 1981. 34 p, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, Dye releases, *Mississippi, Goodwater Creek, Okatoma Creek, Time of travel.

An intensive quality-of-water study was conducted during a period of generally low streamflow in Goodwater and Okatoma Creeks near Magee, Miss. During the August 12-14, 1980, study, the mean specific conductance of the water at all sites was less than 59 micromhos per centimeter; the dissolved-oxygen concentrations were greater than 5.0 milligrams per liter: pH values ranged from 6.0 to 6.8, and the mean water temperature ranged from 23.0 to 27.0 Celsius. The biochemical oxygen demand and nutrient concentrations at the downstream sampling sites were higher in Goodwater Creek than in Okatoma Creek. The maximum 5-day biochemical oxygen demand was 2.7 milligrams per liter in Goodwater Creek and 1.5 milligrams per liter in Okatoma Creek. The mean concentration of total nitrogen was 1.0 and 0.71 milligrams per liter and the mean total phosphorus concentration was 0.26 and 0.10 milligrams per liter at the downstream sites on Goodwater and Okatoma Creeks, respectively. Fecal coliform densities generally were high at all sites, exceeding 4,000 colonies per 100 milliliters in both Goodwater and Okatoma Creeks. Objectionable concentrations of total cadmium, mercury, iron, and phenol were present in a sample of water. Dieldrin, chlordane, DDD, DDE, and DDT were present in a sample of bottom material collected at the downstream site of Okatoma Creek. The peak concentration of dye injected into Goodwater Creek traveled through a 1.7-mile reach at a rate of 0.3 mile per hour. (USGS)
W82-05845

QUALITY OF WATER AND TIME OF TRAVEL IN LITTLE COPIAH CREEK NEAR CRYSTAL SPRINGS, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1069, 1981. 31 p, 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, Dye releases, *Mississippi, Little Copiah Creek, Time of travel.

An intensive quality of water study was conducted on Little Copiah Creek in the vicinity of Crystal

Springs, Miss., from August 19 to August 21, 1980. The quality of water in Little Copiah Creek improved 7 miles downstream of a source of wastewater inflow. The mean total nitrogen concentration decreased from 17 to 1.1 milligrams per liter and the mean total phosphorus concentrations decreased from 5.8 to 0.39 milligrams per liter. The maximum five-day biochemical oxygen demand decreased from 14 to 1.4 milligrams per liter while the dissolved-oxygen concentration increased from 2.0 to 6.9 milligrams per liter. The maximum fecal coliform and fecal streptococcus densities at the upstream sampling site were 2,200 and 6,700 colonies per 100 milliliter, respectively, and were observed to decrease downstream to 160 and 1,500 colonies per 100 milliliters. The mean stream temperatures decreased downstream only slightly from 26.5 to 25.0 Celsius and the pH of the water ranged from 7.2 to 7.4 units upstream and 6.5 to 7.0 units at the downstream site. The average rate of dye travel through the upstream 2.3 mile reach was 0.08 miles per hour during the study. (USGS)
W82-05847

INDICATOR BACTERIA SURVIVAL UNDER LABORATORY CONDITIONS,
Marquette Univ., Milwakee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-05853

STATISTICAL ANALYSIS TO DERIVE IMPROVED STORMWATER QUALITY MODELS,
Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, and D. D. Adrian.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 489-499, May, 1982. 3 Fig, 11 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Storm water, *Water quality, Model studies, Urban runoff, Runoff, Hydrologic models, Statistical analysis, Fate of pollutants, Pollution load, Rainfall intensity.

Statistical analysis of storm water quality models revealed that no one model was consistently better than others in predicting storm water pollutant washoff. Even when the same model fit well for several basins, the estimated parameter values varied significantly among the basins. Therefore, calibration of an existing model is not advisable for predicting storm water quality. A better procedure would be to gather data from each basin under study and develop models from this data. The primary independent variables were total volume of runoff for storm total analyses and runoff intensity for instantaneous flux analyses. Also used as independent variables in selected models were storm duration, time since start of storm, particulate fallout, population density, and percentage impervious area. Fourteen models for storm event total loadings and 15 models for instantaneous flux were analyzed. (Cassar-FRC)
W82-05857

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES. II. KNYSNA RIVER,
National Physical Research Lab., Pretoria (South Africa).
R. J. Watling, and H. R. Watling.
Water S. A., Vol 8, No 1, p 36-44, January, 1982. 5 Fig, 6 Tab, 11 Ref.

Descriptors: *Estuaries, *Trace metals, Oysters, Estuarine environment, Knysna River, South Africa, Zinc, Copper, Cadmium, Cobalt, Thesen's Island, Lead, Sediments, Monitoring, Rivers, Water pollution sources.

A survey was conducted to determine metal levels in the Knysna estuary and the rivers leading to it. Surface and bottom water samples were taken from up to 25 sites at low tide during May 1977. Metal levels in surface waters were generally higher in the river, gradually decreasing towards the national road bridge, after which concentrations remained relatively constant in the rest of the estuary. Cobalt and mercury levels did not follow this pattern. Surface sediments in the estuary demonstrated that the estuary is relatively unpolluted with respect to tract metals. Metal levels in the drain sediments were considerably higher than those in the normal estuarine sediments, as expected. Twelve sediment cores were also collected. Four sites of metal accumulation of a relatively long-lived nature were identified, including Thesen's Island point, close to the Leisure Isle resort, with high cadmium levels; and Thesen's Island jetty, where there are elevated levels of cadmium, chromium, zinc, cobalt, and nickel. It is suggested that there was once a localized source of these metals which now no longer exists. As yet the Knysna Lagoon is considered relatively unpolluted. Metal concentrations in Crassostrea gigas and Ostrea edulis from the Knysna estuary are much lower than many of the reported values for these species. (Baker-FRC)
W82-05897

5C. Effects Of Pollution

ACID PRECIPITATION. 1. CAUSES AND CONSEQUENCES,
Environmental Law Inst., Washington, DC.
H. Babich, D. L. Davis, and G. Stotzky.
Environment, Vol 22, No 4, p 6-13, 40-41, May, 1980. 4 Fig, 1 Tab, 74 Ref.

Descriptors: *Acid rain, Air pollution, Rainfall, Air pollution effects, *Environmental effects, Aquatic environment, Ecosystems, *Hydrogen ion concentration, *Ecological effects.

The causes of acid precipitation are detailed and its consequences for the abiotic and biotic components of the terrestrial and aquatic ecosystems and for natural and man-made materials are described. Acid precipitation is defined as rain or snow with pH values of less than 5.6. The incidence and severity of acid precipitation falling over the United States, Canada, and most of western Europe had increased significantly within the last 20 to 25 years. Acid precipitation is associated with industrial and automotive emissions of sulfur oxides, nitrogen oxides, and gaseous hydrogen chloride resulting from the combustion of fossil fuels. These pollutants may remain in the atmosphere for several days, during which they may be transported large distances, sometimes exceeding 500 miles, before being deposited on water or land surfaces. Acid precipitation may have a toxic effect on indigenous plants and animals by altering the chemical composition of the land or aquatic environments on which it is deposited. Soil type is a factor in determining the susceptibility of terrestrial environments to acid precipitation. The pH of some soils may be lowered, or the leaching of calcium, magnesium, or heavy metals from the soil may be accelerated. In addition, acid rain may adversely affect the reproductive success of some terrestrial animals and cause a variety of plant growth and foilage damage problems. The pH of lakes or streams may be lowered, resulting in the release of toxic heavy metals, the disappearance of fish populations, a reduction in the microbial decomposition processes, and a general lowering of the fertility of the aquatic ecocystem. Acid precipitation has also been shown to promote the corrosion of metals, particularly iron and iron-containing alloys, and the deterioration of stone and marble sructures. (Carroll-FRC)
W82-04771

KINETIC MODELING OF THE OZONATION OF PHENOL IN WATER,
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
J. A. Roth, W. L. Moench, Jr., and K. A. Debalak.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 135-139, February, 1981. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Kinetics, *Phenol, *Ozonation, Model studies, *Wastewater treatment, *Industrial wastewater, Mass transfer, Chemical reactions.

A model for predicting the extent of the gas-liquid reaction between ozone and phenol was developed from bench-scale studies. This is relevant to ozonation of phenols in industrial wastewater streams. Experimental data showed first-order dependence with respect to phenol. The model was fit to data obtained from semibatch and continuous stirred tank reactor studies. Analysis of data by other investigators produced model parameters which compared well with results of this study. Gram-moles of phenol removed vs, gram-moles of ozone consumed were plotted on a graph, not distinguishing between ozone reacting with phenol and intermediates and ozone which self-decomposes. For complete removal of phenol, 4-6 moles of ozone were required. (Cassar-FRC)
W82-04780

ALTERNATIVE APPROACH TO ASSESSING WATER QUALITY IMPACT OF WASTEWATER EFFLUENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-04788

COSTS FOR SMALL SYSTEMS TO MEET THE NATIONAL INTERIM DRINKING WATER REGULATIONS,
North Carolina Utilities Commission, Raleigh.
R. G. Stevie, and R. M. Clark.
Journal of the American Water Works Association, Vol 74, No 1, p 13-17, January, 1982. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Costs, *Water treatment, *Economies of scale, Water quality standards, *Small water systems, Water quality control, Financing, Regulations, Water supply.

More than 95% of the water suppliers in the United States are small systems, serving fewer than 10,000 people. The increased water quality demands of the National Interim Drinking Water Regulations (NIPDWR) have a special financial impact on small systems because of their characteristics cost patterns and financing possibilities. The existence of positive economies of scale is a pervasive characteristic of water supply technology. The increasing financial burden imposed by NIPDWR will increase pressure in the direction of regionalization or joining small water companies to adjacent large ones. An analysis was undertaken of the costs of required new technolgy in 23 small water utilities from EPA regions 3,5 and 6. Seven of the utilities were determined to suffer from potential NIPDWR violations. cost impacts were calculated for proposed treatments to solve these violations. Cost increases ranted from 1.3 cents/1000 gal for chemical oxidation to remove excessive manganese to $4.18/1000 gal for lime softening to remove excessive barium. (Carroll-FRC)
W82-04793

FACTORS AFFECTING THE RECOVERY OF ISH POPULATIONS IN AN INDUSTRIAL RIVER,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. W. H. Turnpenny, and R. Williams.
Environmental Pollution, Series A, Vol 26, No 1, p 39-58, 1981. 6 Fig, 6 Tab, 31 Ref.

Descriptors: *Fish populations, *Water pollution control, Water quality, Fish, Stream improvement, Toxicity, Hydrogen ion concentration, Dissolved oxygen, Industrial wastewater, *Wales, Great Britain, Ebbw Fawr.

The Ebbw Fawr is a river located in southeast Wales which was rendered virtually devoid of fish by industrial pollution over 100 years ago. Progressive improvements in water quality have been achieved since the early 1960s with the introduction of various pollution control measures. Significant water quality improvements have resulted from the installation of pollution control measures at coal washeries and a steelworks on the river in the early 1970s. These pollution control measures have been successful in reducing the levels of toxic materials in the river and in restoring dissolved oxygen levels and pH values acceptable to fish.

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The brown trout was the first freshwater fish species to become reestablished in parts of the river between 1974 and 1977. The trout was followed by eel, stoneloach, strickleback, and bullhead species. Calculated toxicities and the results of fish caging tests indicated that water quality was satisfactory for fish populations throughout the river, with the possible exception of a short reach immediately below the steelworks. The limited numbers of fish available for recolonization and the restrictions on their movements resulted in the failure of the fish to recolonize some upstream reaches having good water quality. Although good growth and condition factors among the recolonizing brown trout stock suggest that a sport fishery could be developed on the river, stocking with hatchery-reared fish will be necessary for some time due to residual silt pollution which inhibits spawning. (Carroll-FRC)
W82-04812

TOXICITIES OF PARAQUAT AND METRIBUZIN (SENCOR) HERBICIDES TO THE FRESHWATER COPEPODS, EUCYCLOPS AGILIS AND DIAPTOMUS MISSISSIPPIENSIS,
Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
S. M. Naqvi, T. S. Leung, and N. Z. Naqvi.
Environmental Pollution, Series A: Ecological and Biological, Vol 26, No 4, p275-280, December, 1981. 3 Tab, 13 Ref.

Descriptors: *Herbicides, *Toxicity, *Copepods, *Water pollution effects, Aquatic animals, Crustaceans, Paraquat, Metribuzin, Bioassay, Mortality.

The acute toxicities of the herbicides, paraquat and metribuzin, on freshwater copepods were determined by 24- and 48-hour static bioassay tests. Zooplanktonic organisms were collected from Lake Kernan and acclimatized for 96 hr in 90-liter aquaria containing lake water. Copepods were separated by passing through a plankton net into a vial, where they accumulated at the top of the vial. The copepod population was comprised of 91% calanoids (Diaptomus mississippiensis March) and 9% cyclopoids (Eucyclops agilis Koch). The 24-hour LC50 values for paraquat and metribuzin were 10 and 205 ppm; the 48-hour LC50 values, 5 and 150 ppm, respectively. Mortality rates off the copepods due to herbicide exposure were dosage dependent and directly proportional to exposure time. A 1:1 mixture of the two herbicides was less toxic than paraquat and more toxic than metribuzin. LC50 values for the mixture were 29.1 ppm for 24 hours and 17.1 for 48 hours. (Cassar-FRC)
W82-04814

THE ASSESSMENT OF THE POSSIBLE INHIBITORY EFFECT OF DYESTUFFS ON AEROBIC WASTE-WATER BACTERIA, EXPERIENCE WITH A SCREENINT TEST,
Imperial Chemical Industries Ltd., Brixham (England).
D. Brown, H. R. Hitz, and L. Schaefer.
Chemosphere, Vol 10, No 3, p 245-261, 1981. 5 Fig, 8 Tab, 14 Ref.

Descriptors: *Dyes, *Activated sludge process, *Bacteria, *Water pollution effects, Wastewater treatment, Sewage bacteria, Inhibition, Respiration Oxygen uptake, *Aerobic bacteria, Industrial wastewater, Chemical wastewater.

A rapid screening test for assessing the possible inhibitory effects of dyestuffs on aerobic wastewater bacteria was developed and tested. Respiration rates of bacteria in activated sludge with and without the chemical under test were compared. Chemicals may be screened in a series at the 100 mg per liter level, or one chemical may be tested at several concentrations over the range < 1 to > 100 mg per liter. An activated sludge concentration of 1600 mg per liter, about half that in many sewage plants, was used to confine the oxygen uptake rates to a convenient range. Recommended contact time was 32 hours, and recommended pH range, 7-8. One year of testing 202 dyes showed that 19, all in the Basic Dye Group, had IC50 (50% inhibition concentrations) less than 100 mg per liter. Other groups of dyes tested were Acid, Direct, disperse, Reactive, ad Miscellaneous. The chemical 3,5-dichlorophenol was found suitable as a procedural check. (Cassar-FRC)
W82-04825

EFFECT OF MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology London (England). Public Health Engineering Lab.
L. A. Obeng, J. N. Lester, and R. Perry.
Chemosphere, Vol 10, No 9, p 1005-1009, September, 1981. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Nitrilotriacetic acid, *Mixed liquor solids, *Biodegradation, Degradation, Wastewater treatment, *Activated sludge process, Detergents, *Heavy metals, Metals, Water pollution effects, Fate of pollutants, Chelation.

Biodegradation of nitrilotriacetic acid (NTA) and heavy metal removal were studied in a laboratory-scale activated sludge system at two concentrations of mixed liquor suspended solids (MLSS), 2000 and 4000 mg per liter. Heavy metals in the influent sewage ranged from 0.1 to 0.5 mg per liter (Cd, Cr, Cu, Ni, Pb, and Zn). A 10 mg per liter dose of NTA added to the activated sludge system produced effluent concentrations of 0 to 1 mg per liter NTA for the 4000 mg per liter MLSS and 0 to 3 mg per liter for the 2000 mg per liter MLSS. Metal levels in the effluent were lower than in the influent. Doubling the NTA levels to simulate a wash day increased effluent NTA levels to 10 mg per liter in the 2000 mg per liter MLSS and to 5 mg per liter in the 4000 mg per liter MLSS. Doubling the NTA concentration did not have any adverse effects on suspended solids or COD removal. (Cassar-FRC)
W82-04829

A ONE YEAR STUDY OF THE SEASONAL VARIATIONS OF SDDT AND PCB LEVELS IN FISH FROM HEATED AND UNHEATED AREAS NEAR A NUCLEAR POWER PLANT.
National Swedish Environment Protection Board, Stockholm.
M. Edgren, M. Olsson, and L. Reutergardh.
Chemosphere, Vol 10, No 5, p 447-452, May, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Fish, *Thermal pollution, *Chlorinated hydrocarbons, *Water pollution effects, Perch, Roach, Cooling water, Insecticides, Pesticides, DDT, Polychlorinated biphenyls, *Nuclear powerplants, Seasonal variation, Simpevarp, *Sweden.

Perch living in the heated water discharges of a nuclear power plant at Simpevarp, Sweden, had higher levels of DDT and polychlorinated biphenyls than perch in the intake areas. The difference in temperature between the two sites was 4 to 10C. No significant differences in organochlorine levels were found in roach from the two locations. Levels of DDT and polychlorinated biphenyls were highest in spring and early summer and lower in autumn. (Cassar-FRC)
W82-04836

EFFECTS OF SULFURIC ACID RAIN ON MAJOR CATION AND SULFATE CONCENTRATIONS OF WATER PERCOLATING THROUGH TWO MODEL HARDWOOD FORESTS,
Corvallis Environmental Research Lab., OR.
J. J. Lee, and D. E. Weber.
Journal of Environmental Quality, Vol 11, No 1, p 57-64, January-March, 1982. 5 Fig, 2 Tab, 40 Ref.

Descriptors: *Acid rain, *Forest watersheds, *Ecosystems, Percolation, Soil types, Forest soils, Forest management, Sulfuric acid, Nitric acid, Acidity, Leaching, Cycling nutrients, Water pollution sources, Groundwater, Ecological effects.

Changes are reported in pH, calcium, magnesium, potassium and sulfate ions in acid rain as it percolates through experimental forest ecosystems. The findings indicate that interaction with a well developed hardwood canopy and litter layer can significantly raise the pH and increase concentrations of basic cations in rainwater along with increasing concentrations of sulfate ions. Increased anion concentrations in soil solutions will cause increased concentrations in soil solutions, will cause increased concentrations of cations, which would immediately lead to increased leaching of basic cations from the soil and to decreases in the pH of the soil solution. Sulfuric acid rain, however, may not cause significantly higher sulfate concentrations in soil solutions until the ability of the soil to adsorb sulfate is exhausted. For a strong sulfate adsorber, this might occur after a year or two for rain at pH 4.0. The response of soil solutions to nitric acid rain could be more rapid, but lower in magnitude. The various layers of the model ecosystems responded differently to the sulfuric acid rain, emphasizing that the effects of acid precipitation on forest soils can only be adequately studied in an ecosystem context. (Baker-FRC)
W82-04872

EFFECT OF LONG TERM EXPOSURE TO PETROLEUM ON MIXED FUNCTION OXYGENASES IN FISH: FURTHER SUPPORT FOR USE OF THE ENZYME SYSTEM IN BIOLOGICAL MONITORING,
Dept. of Fisheries and Oceans, St. John's (Newfoundland).
J. F. Payne, and L. L. Fancey.
Chemosphere, Vol 11, No 2, p 207-213, 1982. 1 Tab, 30 Ref.

Descriptors: *Fish, *Oil spills, *Enzymes, *Water pollution effects, Fate of pollutants, Codfish, Flounder, Sculpin, Toxicity, Mixed function oxygenases, Oil pollution, Monitoring, Hydrocarbons.

Fish were exposed at ambient temperatures in laboratory aquariums to low levels of petroleum hydrocarbons in sediments for several months to determine mixed function oxygenase (oxidase) (MFO) response. Three species at three different stages of the sexual cycle were studied: spawning codfish (Gadus morhua), post-spawned sculpins (Myoxocephalus octodecemspinosus), and gonadally maturing flounder (Pseudopleuronectes americanus). MFO activity was elevated 4-fold in the liver and 3-fold in the gills of codfish exposed for 4 months to concentrations of 0.30-0.60 ppm petroleum at temperatures of -1 to +1 C. Liver enzyme activity remained elevated 3-fold in sculpins exposed to 0.15 to 0.20 ppm of petroleum for 3 months at 4-12 C. Using an oil-contaminated sediment weathered for 1 year induced a 7-fold level of MFO activity in flounder. Several factors that might detract from use of the MFO system in biological monitoring did not interfere. These were sex, state of sexual maturity, small number of animals, and the codfish's large fatty liver, which could possibly negate induction. (Cassar-FRC)
W82-04884

PETROLEUM REFINERY WASTEWATER INDUCTION OF THE HEPATIC MIXED-FUNCTION OXIDASE SYSTEM IN PACIFIC STAGHORN SCULPIN,
Northrop Services, Inc., Corvallis, OR.
J. W. Ridlington, D. E. Chapman, B. L. Boese, and V. G. Johnson.
Archives of Environmental Contamination and Toxicology, Vol 11, No 1, p 123-127, 1982. 4 Tab, 16 Ref.

Descriptors: *Industrial wastes, *Estuarine environment, Aquatic life, Pollution effects, Water quality, Enzymes, *Yaquina Bay, *Oregon, *Oil industry.

The purpose of this study was to establish the presence of cytochrome P-450 and mixed function oxidase (MFO) in the ubiquitous estuarine sculpin, Leptocottus armatus, and to determine whether induction of these enzymes occurs as a result of exposure to petroleum refinery wastewater. Immature Pacific staghorn sculpin were collected from tidal channels in Yaquina Bay, Oregon, by 15 meters beach seine. Wastewater was collected from two Class B refineries and stored at 1 to 4

degrees C. The microsomal cytochrome P-450 linked mixed function oxidase system was found to be present in staghorn sculpin. The increase in cytochrome P450 in response to beta-naphtholflavone injection indicated that at least part of this system is inducible by an aromatic hydrocarbon known to induce MFO activity in other fish. Different wastewaters were able to induce sculpin MFOs to different degrees, probably due to differences in aromatic hydrocarbon content. (Baker-FRC)
W82-04895

THE NEW POLLUTION--GROUNDWATER CONTAMINATION,
D. E. Burmaster.
Environment, Vol 24, No 2, p 6-13, 33-36, March, 1982. 2 Fig, 7 Tab, 35 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Public health, Fate of pollutants, Water pollution sources, Regulations, Chlorinated hydrocarbons, Wells, Water supply, Drinking water, Carcinogens, Risks, Water quality standards, Water pollution effects.

Groundwater, considered in the past to be a pristine resource, is vulnerable to contamination from human activities: surface impoundments, landfills, agriculture, leaks and spills, land disposal of wastewater, septic tanks, mining, petroleum and gas production, and injection wells. Once contaminated with nonbiodegradable organic chemicals, groundwater may remain so for hundreds or thousands of years. The degree of threat to groundwater depends on local geology and hydrological conditions. If plumes of pollution move very slowly, it may take decades for contamination to reach a water supply. Monitoring this movement is very expensive. Toxic organic chemicals have been found in many municiplal and private wells throughout the U.S. Areas with major problems are states east of the Mississippi River and several sparsely populated western states. Crude estimates of cancer risks from using water from chemically-contaminated wells were possible in a few cases. In Nassau County, Long Island, where groundwater contains high levels of chlorinated hydrocarbons and other organic chemicals, it is estimated that a additional 750 people out of a million population will contract cancer in their lifetimes as a result of exposure to these chemicals in drinking water. The EPA has adopted maximum contaminant levels for pollutants in drinking water for a few substances, including trihalomethanes, but for most of the synthetic organic compounds found in groundwater supplies there are no proposed standards to date. (Cassar-FRC)
W82-04938

THE DECLINE OF SALVINIA MOLESTA ON LAKE KARIBA,
Lake Kariba Fisheries Research Inst., (Zimbabwe).
For primary bibliographic entry see Field 2H.
W82-04945

BENTHOS AND ZOOPLANKTON OF COAL STRIP MINE PONDS IN THE MOUNTAINS OF NORTHWESTERN COLORADO, U.S.A.,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
S. P. Canton, and J. V. Ward.
Hydrobiologia, Vol 85, No 1, p 23-31, 1981. 3 Fig, 4 Tab, 29 Ref.

Descriptors: Invertebrates, Mine drainage, Water quality, *Strip mine wastes, *Benthos, Benthic fauna, *Zooplankton, *Colorado, Physicochemical properties, *Ponds, Water pollution effects, Species diversity, Spoil banks, Aquatic fauna, Coal mines, Ecological effects.

Zooplankton, benthic fauna, and physicochemical parameters were studied in four ponds in a coal strip mine region of northwest Colorado from July 1977 to May 1978. Pond 1, age 10 years, received mine drainage. Pond 2, age over 30 years, received mine drainage. Pond 3 received partial mine drainage. Pond 4, control, received no mine drainage. The spoils ponds received no acid mine drainage (pH of all ponds, 7.4-7.6) but were higher in total dissolved solids, nitrate, and sulfate than the control pond. The younger spoils pond was lowest in zooplankton density and diversity, but benthic invertebrates were highest in Pond 1, decreasing in order through Pond 4. Pond 1 contained few or no Cladocera, Trichoptera, Amphipoda, Hydracarina, and Sphaeriidae. It is believed that the younger spoils pond had lower density and diversity because colonizers did not yet have the opportunity to become established because of either distance or time. In addition, nitrate, sulfate, and total dissolved solids levels in Pond 1, although higher than in the other ponds, were not outside tolerable limits for the aquatic species. (Cassar-FRC)
W82-04946

ECOLOGICAL EFFECTS OF URBAN STORM-WATER RUNOFF ON BENTHIC MACROINVERTEBRATES IHIBITING THE GREEN RIVER, MASSACHUSETTS,
Massachusetts Univ., Amherst, Dept. of Environmental Sciences.
J. M. Pratt, R. A. Coler, and P. J. Godfrey.
Hydrobiologia, Vol 83, No 1, p 29-42, 1981. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Storm runoff, Rivers, *Massachusetts, Benthos, Runoff, Storm water, *Urban runoff, Aquatic life, Population dynamics, Aquatic populations, Water pollution, *Green River, *Ecological effects.

The purpose of this study was to investigate the long term effects of urban runoff on the benthic community in the Green River, Massachusetts. The Green River originates in south-central Vermont and flows in a southerly direction, 32 km before joining the Deerfield River near Greenfield, Massachusetts. The water quality is typically good upstream but deteriorates immediately after passing through an urban reach. Four analytical procedures were used: species diversity (the Brillouin index), hierarchical diversity, major taxa composition, and collection dissimilarity at the species level. The overall results from these four analytical studies strongly indicated that the macrobenthic community became progressively disrupted downstream in the urban reach. The high degree of correspondence between the known sources of urban runoff and the observed effects on the benthic community are forceful arguments that urban runoff is the casual agent of disruption. The impact is not confined to periods following heavy rains. The stress was heaviest in the summer low flow and was probably localized in or near the stream bed. Monitoring of physical, chemical, and biological parameters should be undertaken to understand the stream bed microzone. Urban runoff pollutant loading standards must take into account the apparent long term residence of pollutants in the substrate and the associated stress of summer low flows. (Baker-FRC)
W82-04947

THE EFFECTS OF DISSOLVED HEAVY METALS ON ATTACHED DIATOMS IN THE UINTAH BASIN OF UTAH, U.S.A.,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 5A.
W82-04951

BEHAVIOR OF ORGANIC PRIORITY POLLUTANTS IN THE TERRESTRIAL SYSTEM: DI-N-BUTYL PHTHALATE ESTER, TOLUENE, AND 2,4 DINITROPHENOL,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-04965

RARE AND ENDANGERED SPECIES: FRESHWATER GASTROPODS OF SOUTHERN NEW ENGLAND,
Connecticut Univ., Storrs.
E. H. Jokinen, and J. Pondick.
Bulletin of the American Malacological Union, 1981, p 52-53, 1 Tab, 6 Ref.

Descriptors: Snails, *Endangered species, Connecticut, *Gastropods, Cincinnatia cincinnatiensis, Amnicola walkeri, Pomatiopsis lapidaria, Goniobasis virginica, *Acid rain, Air pollution fallout, *New England, *Ecological effects, Endangered species.

The rare and endangered species of freshwater gastropods of southern New England are reported on based upon data collected over the past four years. Field sampling was concentrated in Connecticut but included parts of southern Massachusetts east to Cape Cod (69 55 W to 73 45'W, 40 00'N). Water chemistry data were collected along with the snails. Collection methods and water analysis techniques have been described elsewhere by Jokinen (The Nautilus 92:156-160, 1978). Voucher specimens have been placed in the Museum of Comparative Zoology, Harvard University, the Florida State Museum, and the Museum of Zoology, the University of Michigan. Acid rain poses a threat to poorly buffered habitats.
W82-04968

TOXICITY OF ANAKEESTA FORMATION LEACHATES TO SHOVEL-NOSED SALAMANDER, GREAT SMOKY MOUNTAINS NATIONAL PARK,
Tennessee Technological Univ., Cookeville.
R. C. Matthews, Jr., and E. L. Morgan.
Journal of Environmental Quality, Vol 11, No 1, p 102-106, January-March, 1982. 2 Fig, 2 Tab, 31 Ref.

Descriptors: *Leachates, *Toxicity, Highways, *Highway effects, Infiltration, Percolation, Water pollution sources, *Salamanders, *Great Smoky Mountains National Park.

In 1963 following relocation of U.S. Highway 441 near Newfound Gap in the Great Smoky Mountains National Park, aquatic life in a headwater stream, Beech Flats Prong, was severely disrupted. Attempts to restock the stream with brook trout at various times after highway completion failed. Toxic substances were not identified until almost a decade later in leachate from roadfill materials consisting of pyrite-containing Anakeesta rock. Toxic metals, especially Al and lesser quantities of Cu and Zn, are dissolved and transported by acidic leachates generated by redox actions of metal sulfides. The toxicity of leachates produced in the laboratory from Anakeesta rock and stream reference water was investigated in 96-hr bioassays with the shovel-nosed salamander, Leurognathus mamoratus, abundant in the park. After 48 hr of exposure at leachate concentrations of about 50%, mortality of about half of the salamanders present occurred. The mortality rate was a function of exposure time and concentration. The exact mechanism of death is unknown. Similar problems may be anticipated in other areas where this type of rock formation occurs. (Baker-FRC)
W82-04988

THERMAL FRONT FORMATION FROM BUOYANT SURFACE JETS,
Alaska Univ., Fairbanks. Geophysical Inst.
J. P. Gosink.
Journal of the hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No Hy2, p 252-257, February, 1982. 2 Fig, 17 Ref.

Descriptors: *Thermal water, *Powerplants, *Froude number, *Mathematical studies, *Thermal pollution, *Jets, Electric powerplants, Nuclear powerplants, Water pollution effects, Thermal powerplants, Heated water, Waste heat, Temperature effects, Temperature gradient.

Electric generating plants powered by nuclear or fossil fuels produce waste heat that is usually released into a stream or water basin as a horizontal buoyant jet causing great elevations in temperature in the receiving waters. Concentric thermal waves also radiate from such outfalls. An attempt was made to explain the formation of thermal fronts for outfall Froude numbers in the range of F less than or equal to 3.3. Using experimental and theoretical data, it was demonstrated that the homogeneous round jet has a characteristic natural frequency in

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the range 0.3 > Strouhal number < 0.5 which is damped out beyond the ration of some distance x/D (the jet diameter) greater than or equal to 5. Instabilities in the form of thermal fronts may increase and spread radially from the outfall if the brunt-Vaisala frequency of the ambient basin near the outfall is greater than or equal to the characteristic jet frequency. These findings may be useful in designing warm water diffusers. To minimize the occurrence to steep thermal gradients associated with thermal fronts, outfall Froude numbers < 3.3 should be avoided. More research into the behavior of thermal fronts is needed to protect aquatic organisms from the steep gradients of temperature that may occur with the passage of a thermal front and may be linked to a given range of outfall froude number. (Geiger-FRC)
W82-05004

DETECTION OF DIETHYLNITROSAMINE IN NITRITE-RICH WATER FOLLOWING TREATMENT WITH RHODAMINE FLOW TRACERS,
National Fishery Research Lab., La Crosse, WI.
For primary bibliographic entry see Field 5B.
W82-05022

LIMNOLOGICAL STUDY OF A FRESHWATER RESERVOIR, JAMWA RAMGARH (JAIPUR).
Rajasthan Univ. Jaipur (India). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W82-05102

INITIAL MICROBIOLOGICAL RESPONSE IN LAKES TO THE MT ST HELENS ERUPTION,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2H.
W82-05125

PESTICIDE EFFECTS ON AQUATIC HABITATS,
Hamburg Univ. Inst. fuer Hydrobiologie und Fischereiwissenschaft (Germany, F.R.).
C. W. Heckman.
Environmental Science and Technology, Vol 16, No 1, p 48A-57A, January, 1982. 3 Tab, 42 Ref.

Descriptors: *Pesticides, *Aquatic habitats, Ecosystems, Aquatic environment, Agricultural chemicals, *Ecological effects.

Only a small percentage of the studies of the effects of pesticides have addressed the effects of pesticides on aquatic habitats. Water bodies may be affected by contamination from persistent agricultural chemicals which find their way into nearby water bodies, from direct application to rice fields or marshes, from wastewater released to water bodies, or from localized direct applications to make a water body more suitable for a selected purpose. Application of pesticides to orchards or other agricultural land may drastically reduce both the number of species and the numbers of individuals within each species remaining in adjacent drainage ditches or other water bodies. Pesticides which find their way into water bodies frequently eliminate food organisms for the fish, such as insects, small crustaceans, or rotifers, leading to subsequent reductions in fish populations. Many agricultural pesticides which are subject to severe use restrictions in industrial countries continue to be used in developing countries, where there are few persons trained to evaluate the ecological stresses on biota or their effectiveness in meeting agricultural objectives. Some of the problems caused by extensive pesticide application programs in these countries could be avoided if the international development aid organizations which finance these efforts would provide adequate monitoring programs and planning support. (Carroll-FRC)
W82-05146

EFFECTS OF ACID PRECIPITATION,
Environmental Protection Agency, Corvallis, OR.
N. R. Glass, D. E. Arnold, J. N. Galloway, G. R. Hendrey, and J. J. Lee.
Environmental Science and Technology, Vol 16, No 3, p 162A-169A, March, 1982. 4 Fig, 4 Tab, 23 Ref.

Descriptors: *Acid rain, *Environmental effects, Sulfuric acid, Pollution effects, Water pollution sources, Reviews, Public health, Appalachian Mountains, Coal, Fuel, Lakes, Ecological effects.

Acid precipitation has become a widespread problem due to the ubiquitous nature of the pollution sources cntributing to acid precipitation and the ease with which the emissions causing it are carried by moving air masses. Serious symptoms of acidification have been documented in lakes of New York's Adirondack Mountains, far removed from any industrial activity. While precipitation is most acidic in the northeast US, the geographic extent of the problem encompasses the southeast and portions of the midwest and far west. A growing body of evidence suggests that acid precipitation adversely affects public welfare through loss of fish and other aquatic life, increased leaching of nutrient cations from the soil, possible reductions in crop and forest productivity, and the release of heavy metals or nutrients from rocks, soils and lake and stream bottom sediments. Research on aspects of acid rain is reviewed. The sensitivity of surface water bodies to acid precipitation was evaluated, and historical changes in surface waters were documented. (Baker-FRC)
W82-05149

ENZYMES AND OTHER BIOCHEMICAL INDICATORS OF TOXICANT EFFECTS IN FISHES,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. R. M. Passino.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 19-43, 3 Fig, 2 Tab, 14 Ref. 3 Append.

Descriptors: *Bioassay, *Bioindicators, *Enzymes, *Fish, *Water pollution, Pollutants, Pesticides, Lead, Mortality, Chlorinated hydrocarbons, Growth, Population dynamics, Polychlorinated biphenyls, DDE, Dieldrin, Chlordane, *Pollutant identification.

Enzymes and reproductive hormones may be used as biochemical indicators of toxicant effects in aquatic organisms. Lake trout in the Great Lakes have suffered a serious population decline caused by excessive fishing and predation, but also possibly by the effects of pollutants, since natural reproduction of planted fish is almost non-existent. Two fish enzymes have been identified as indicators of specific contaminants or classes of contaminants. Acetylcholinesterase is inhibited by organophosphate insecticides, while lead inhibits delta-amino levulinic acid dehydratase. Detoxifying enzymes, which are induced when an organism is exposed to toxic substances, have been recognized in fish. Lake trout fry mortality was 40.7% when they were exposed to simulated Lake Michigan levels of PCB and DDE, 10 ng/l and 1.0 ng/l, respectively. A slight increase in growth was observed in the exposed fish. A similar increase in growth was observed in lake trout eggs and fry exposed to simulated Lake Michigan levels of organochlorines, 1 ng/l PCB, 0.2 ng/l DDE, 1 ng/l dieldrin, and 0.9 ng/l technical grade chlordane. The exposed fish had a higher RNA/DNA ratio than the controls, supporting the trend towards increased growth. Reproductive and steroid hormones have been shown to be affected by contaminants. The baseline levels for such chemicals are not known, nor are the effects of season, spawning and migration, so these biochemical indicators can not be used with any certainty yet. (Brambley-SRC)
W82-05155

OVERVIEW AND ASSESSMENT OF BIOLOGICAL SENSING,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
J. D. Koutsandreas.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 45-54.

Descriptors: *Biomonitoring, *Ecosystems, *Aquatic life, *Bioassay, Bioaccumulation, Hazardous materials, Environmental effects, Bioindicators, Water pollution, Air pollution, Soil contamination, Evaluation.

The Environmental Protection Agency is evaluating six approaches to biomonitoring: in-situ bioassays; bioaccumulation; indicator organisms; community and population changes; species health; and integration of biological methods to determine release of toxic substances from hazardous waste operations for air, water, and land. Biological monitoring is defined as the use of a living organism to measure, for a specific time and location, the presence or amount of a substance in the environment or in man, or the effect of a substance on the environment or man. The organism may be a naturally present or introduced species in the environment, or in the laboratory, or in a simulated environment or microcosm. Biological monitoring offers great promise for detecting specific chemicals and has the advantages of greater biological relevance, greater sensitivity, and ability to indicate actual or potential exposures. Most of the emphasis has been on monitoring of aquatic systems, but biological monitoring can be applied to air and terrestrial systems. (Brambley-SRC)
W82-05156

NEW IN-SITU TECHNIQUES IN BIOMONITORING,
BioControl Co., Inc., Port Sanilac, MI.
For primary bibliographic entry see Field 5A.
W82-05157

COMPUTER INTERFACED SYSTEMS FOR BIOLOGICAL MONITORING OF WATER QUALITY,
Virginia Polytecnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-05158

METABOLIC RESPONSE OF FISH TO STRESS,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
D. E. Wohlschlag.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 119-141, 11 Fig, 35 Ref.

Descriptors: *Fish, *Fish behavior, *Metabolism, *Monitoring, *Sublethal effects, *Environmental effects, Water pollution effects, Pollutants, Toxicity, Industrial wastes, Salinity, Water temperature.

Fish may be used to monitor consistency of water quality; establish optimal natural environmental conditions; assess and monitor normal, or sublethal departures from normal, conditions with respect to optimal natural environments; assess and monitor deleterious sublethal stress effects of toxic materials; and predict the long-term outcome of natural or anthropogenic stresses at sublethal levels. Before being used in monitoring tests the standard, routine, and active metabolic rates must be determined on acclimatized fish. Using spotted sea trout, red snapper, and striped mullet, experiments have shown the effects of temperature, salinity, red tide exposure, chronic pollution, and ocean dumped petrochemical waste and pharmaceutical waste on metabolic rates and swimming performance. The metabolic rates declined in proportion to the stress. It may be possible to utilize more or less continuous operations to measure swimming rates and general swimming performances in clean and polluted waters. In appropriate equipment other behavior may be observed and the information added to the knowledge of general bioenergetics of fish populations. (Brambley-SRC)
W82-05159

UTILITY OF THE MICROTOX LUMINESCENT BACTERIAL ASSAY FOR THE RAPID ASSESSMENT OF AQUATIC POLLUTION,

Beckman Instruments, Inc., Carlsbad, CA.
For primary bibliographic entry see Field 5A.
W82-05162

CYANOBACTERIAL BLOOMS: CARBON AND NITROGEN LIMITATION HAVE OPPOSITE EFFECTS ON THE BUOYANCE OF OSCILLATORI,
State Univ. of New York Coll. at Purchase.
A. R. Klemer, J. Feuillade, and M. Feuillade.
Science, Vol 215, No 4540, p 1629-1631, March 26, 1982. 2 Fig, 27 Ref.

Descriptors: *Eutrophication, *Limiting factors, *Algae, Nitrogen, Carbon, Oscillatoria, Nutrients, Lakes, *Cyanophyta, Buoyancy.

Relative gas vacuolation (RGV) and buoyancy in blue-green algae depend on an interaction of light and limiting nutrients that affects relative rates of photosynthesis, growth, and gas-vesicle synthesis. To study dynamics of surface bloom developments, RGV was measured nephelometrically with a modified version of Walsby's technique. After a reduction in the dilution rate of a N-limiting cyclostat, RGV in Oscillatoria rubescens declined along with cell N content, and then stabilized as N content continued to decline. A companion culture was supplied by the same peristaltic pump, but deprived of carbon dioxide by a trap installed in the air line after the reduction in dilution rate. With the removal of carbon dioxide, RGV remained stable at first and then increased as the culture became increasingly limited by inorganic carbon. The effect of carbon dioxide deprivation was also noted in two intially N-limiting cyclostats with constant dilution rates. It was concluded that the relative gas vacuole content of the cell of 0. rubescens decreased with increased N limitation and increased with transitions to inorganic limitation. It is suggested that N limitation has a role in the formation of subsurface population maxima by certain species and that inorganic carbon limitation can contribute to the formation or maintenance of surface blooms. N limitation could promote increased turgor pressure and gas-vesicle collapse by contributing to the accumulation of osmotically active photosynthate, whereas the relief of N limitation would increase the assimilation of photosynthate and would reduce turgor pressure. (Baker-FRC)
W82-05175

ENTRAINMENT MORTALITY OF ICHTHYOPLANKON: DETECTABILITY AND PRECISION OF ESTIMATES,
Oak Ridge National Lab., TN.
D. S. Vaughan, and K. D. Kumar.
Environmental Management, Vol 6, No 2, p 155-162, 1982. 3 Fig, 18 Ref.

Descriptors: *Entrainment, *Powerplants, *Fish, Mathematical studies, Environmental effects, Mortality, Monitoring, Sampling, *Intakes.

The purpose of this paper is to show how a biologist may get the maximum information from entrainment sampling by controlling those aspects of sampling over which he has some control. To aid in the design of a more useful sampling program, a method is presented which examines the interrelationships among the following six variables: sample size at the intake and discharge sampling stations, fractions alive in the intake sample, population mean of entrainment mortality fraction, minimum detectable entrainment mortality, width of the confidence interval, and power of the statistical test. Only the first two are under the control of the biologist. The value of the method presented is that it interrelates controllable aspects of the sampling procedures in a manner that permits achievement of a specified level of detectable entrainment mortality, a specified width of a confidence interval, or a specified level of statistical power. Increasing sample size and/or decreasing sampling mortality will decrease the minimum detectable entrainment mortality, confidence interval width, and type II error for a given level of type I error. (Baker-FRC)
W82-05181

PLACER MINING AND SALMON SPAWNING IN AMERICAN RIVER BASIN, CALIFORNIA,
Bureau of Reclamation, Sacramento, CA.
For primary bibliographic entry see Field 8I.
W82-05200

AN ENVIRONMENTAL HEALTH SURVEY OF DRINKING WATER CONTAMINATION BY LEACHATE FROM A PESTICIDE WASTE DUMP IN HARDEMAN COUNTY, TENNESSEE,
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
For primary bibliographic entry see Field 5B.
W82-05203

SEASONAL TEMPERATURE AND POWER PLANT CHLORINATION EFFECTS ON ESTUARINE INVERTEBRATES,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
S. L. Margrey, D. T. Burton, and L. W. Hall, Jr.
Archives of Environmental Contamination and Toxicology, Vol 10, No 6, p 691-703, December, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Chlorination, *Thermal stress, *Estuaries, *Invertebrates, Estuarine environment, Temperature effects, Seasonal variation, Powerplants, Coastal streams, Eastern United States.

This study investigated the effect of seasonal variations in temperature on the responses of two estuarine invertebrates to interacting chlorine, changes in temperature, and exposure duration conditions simulating powerplant condenser entrainment and effluent discharge conditions. The species selected, opossum shrimp and amphipods, are major food sources for higher organisms along the East Coast of the United States. The situations studied included seasonal temperatures ranging from 15 to 22C; total residual chlorine values of 0.00, 0.15, and 0.30 milligrams per liter; changes in temperature of 2, 6 and 10C; and exposure durations of 0.08, 2.0, and 4.0 hours. The two crustaceans showed a range of sensitivity when tested at various seasonal temperatures. Opossum shrimp were found to be sensitive to powerplant chlorination conditions at both acclimation temperatures, while amphipods were fairly tolerant under the same conditions. Seasonal temperature was an important factor influencing the toxicity of simulated powerplant effluents to these species, with greater mortality occurring at higher seasonal temperatures than at lower temperatures. Seasonal temperature was only a marginal factor in the mortality rates for amphipods. It is suggested that powerplants consider regulating conditions to minimize changes in temperature and total residual chlorine during the summer months in order to minimize the effects on estuarine aquatic invertebrates. (Carroll-FRC)
W82-05204

IMPACT OF HEXAZINONE ON INVERTEBRATES AFTER APPLICATION TO FORESTED WATERSHEDS,
Georgia Univ., Athens. Dept. of Poultry Science.
D. T. Mayack, P. B. Bush, D. G. Neary, and J. E. Douglass.
Archives of Environmental Contamination and Toxicology, Vol 11, No 2, p 209-217, 1982. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Invertebrates, *Forest watersheds, *Herbicides, Water pollution effects, Hexazinone, Aquatic animals, Species composition, Species diversity, Fate of pollutants, *Chattahoochee National Forest, *Georgia, Macroinvertebrates, Pesticide residues, Accumulation, Bioaccumulation, Forest soils, Aquatic plants, Macrophytes, Ecological effects.

The effect of the herbicide hexazinone (useful in reforestation) on aquatic macrophytes and aquatic and terrestrial invertebrates was assessed in the Chattahoochee National Forest, Georgia. Pelletized hexazinone was applied at the rates of 16.8 kg per ha to four small watersheds in the forest on April 23, 1979. One untreated watershed served as a control. During the 8-month monitoring period hexazinone levels in samples of stream water were generally below the 1 ppb detection limit except for three peaks of 10 to 40 ppb in July-August and three very minor peaks at other times. The peaks did not appear to be correlated with storms. Traces of hexazinone or metabolites were found in aquatic macrophytes on a few occasions. The forest floor litter contained residues of hexazinone and metabolites for about 90 days after application. The highest level was 0.18 + or - 0.19 ppm hexazinone (dry weight basis) and 0.10 + or - 0.17 ppm metabolite 5 days after the first rainfall. No major changes in species composition or diversity were detected in aquatic or terrestrial invertebrates. Most samples of aquatic and terrestrial invertebrates contained no detectable herbicide residues. On a few occasions there were detectable hexazinone and/or metabolites at average levels of less than 2 ppm (wet weight basis). (Cassar-FRC)
W82-05206

ALGAL CONDITIONS IN THE CALOOSAHATCHEE RIVER (1975-79) LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. F. McPherson, and H. R. La Rose.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-192345, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 81-81, 1982. 28 p, 7 Fig, 7 Tab, 10 Ref.

Descriptors: *Algae, *Cyanophyta, *Water quality, *Streams, Algal growth, Eutrophication, Nutrients, Phytoplankton, Flow, Seasonal variation, *Florida, *Caloosahatchee River.

Maximum numbers of suspended algae occurred in late spring and early summer, in each of the years 1975-79, in the Caloosahatchee River. Numbers exceeded 100,000 cells per milliliter at all stations sometime during the study. Concentrations decreased during late summer and autumn and were low during winter, except in January 1979 when numbers at most sites exceeded 100,000 cells per milliliter. The January 1979 bloom coincided with large discharges from Lake Okeechobee. During previous winters, discharges and algal numbers were lower. During other seasons, algal blooms occurred most frequently under low-flow or stagnant conditions. The upstream site at Moore Haven, which had the least discharge and was most stagnant, had consistently higher algal concentrations than downstream sites. Blue-green algae were dominant in the river during the summer at the upstream site throughout the year. The percentage of blue-green algae decreased downstream. Concentrations of nitrite plus nitrate nitrogen were inversely correlated with concentrations of algae and decreased to near zero during algal blooms. The low concentrations of these forms of inorganic nitrogen relative to other major nutrients probably favor blue-green algae and limit growth of other algae. Contributions by the basin tributaries to the nutritive condition of the river were small because concentrations of nutrients, algal growth potential, and algae in the tributaries were generally less than those in the river. (USGS)
W82-05222

A PRELIMINARY APPRAISAL OF THE EFFECTS OF AGRICULTURE ON STREAM QUALITY IN SOUTHWEST GEORGIA,
Geological Survey, Doraville, CA. Water Resources Div.
D. B. Radtke, J. B. McConnell, and W. P. Carey.
Geological Survey Water Resources Investigation Open-File Report 80-771, August 1980. 40 p, 15 Fig, 6 Tab, 18 Ref.

Descriptors: *Agricultural chemicals, *Water quality, *Water pollution effects, *Data collections, Sampling, Streams, Surface runoff, Agricultural watersheds, Water quality standards, Water analysis, Pesticides, Organic compounds, Inorganic compounds, Sediment yield, *Georgia, *Agricultural runoff.

Water-quality and suspended-sediment samples were collected in two basins in southwest Georgia

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to identify current or potential water-quality problems resulting from agricultural practices. Samples were collected monthly and during periods of storm runoff from December 1976 through July 1978. Concentrations of chemical constituents relevant to agricultural practices were found to be low, even during periods of storm runoff. Concentrations of total nitrogen and total phosphorus ranged from 0.30 to 1.60 and 0.01 to 0.42 milligrams per liter, respectively. Copper, arsenic, lead-mercury, and zinc concentrations were low and did not exceed Georgia or U.S. Environmental Protection Agency (1977) standards for safe drinking water. Concentrations of suspended sediment and total nitrogen were found to remain relatively constant over a wide range of water discharge. Concentrations of total phosphorus showed a better relation to water discharge at Little River near Lenox than at Spring Creek near Iron City. Dissolved-solids concentrations in both streams generally decreased with an increase in water discharge. Average annual yields of selected consitituents were low. Total nitrogen and total phosphorus yields were 0.60 to 0.63 and 0.04 to 0.06 tons per year per square mile in Little River and Spring Creek basins. Atrazine, butylante, and ethroprop pesticides were detected at concentrations up to 0.91 micrograms per liter in storm-runoff samples collected during the active farming season. (USGS)
W82-05229

THE RIVER TAME--A SHORT HISTORY OF WATER POLLUTION AND CONTROL WITHIN AN INDUSTRIAL RIVER BASIN,
Severn-Trent Water Authority, Birmingham (England).
N. Harkness.
Water Science and Technology, Vol 14, No 1/2, p 153-165, 1982. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *History, *Water pollution control, *Water quality control, Wastewater treatment, Water pollution effects, Birmingham, *England, *Tame River, Urban areas, Rivers, Industrial wastes, River Tame.

Severe pollution of the River Tame, near Birmingham, England, was evident by 1872, when the river water was judged no longer safe for drinking. Legal action was taken about 1870 to prevent sewage disposal in the river and to prevent odors arising from existing wastewater treatment processes. Coal gas works, iron manufacturing, domestic sewage, and paper mills were the main sources of pollution. Many fish kills were recorded during the latter part of the 19th century. The Birmingham Tame and Rea District Drainage Board was established in 1877 to cover pollution control for the region, with its population of 476,000. Nevertheless, pollution, complaints, and legal actions continued, so that by 1918 the river was an open sewer, supporting no fish life. Industrial and domestic wastes continued to pour into the river after World War II. Since then several pollution control measures have imported water quality. Gas manufacturing ceased in 1960, sewage treatment plants were built and improved, sewer overflows were reduced, and purification lakes were built. These measures have been reflected in an increase in the number of species and abudance of fish. (Cassar-FRC)
W82-05242

THE AQUATIC TOXICITY OF ORGANIC COMPOUNDS TO EMBRYO-LARVAL STAGES OF FISH AND AMPHIBIANS,
Kentucky Water Resources Research Inst., Lexington.
J. A. Black, W. J. Birge, W. E. McDonnell, A. G. Westerman, and B. A. Ramey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224601, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 133, 1982. 68 p, 3 Fig, 15 Tab, 43 Ref. OWRT B-071-KY(1), 14-34-0001-0223.

Descriptors: Embryos, Larvea, *Organic compounds, Water quality, *Toxicity, *Larvae, Benzene, Phenol, Toluene, *Fish, *Embryo-larval tests, Predictive toxicology, Aquatic toxicity tests, Amphibians.

Aquatic toxicity tests were conducted on 11 organic compounds considered hazardous to water resources. The toxicity of each compound was evaluated using embryo-larval stages of up to eight fish and amphibian species. Exposure was initiated at fertilization and maintained through 4 days posthatching. The animal test species exhibited varying degrees of sensitivity to the selected toxicants. Combined frequencies for mortality and teratogenesis at 4 days posthatching gave LC-50 ranges of 3.66 to 8.25 mg/L for benzene, 1.16 to 22.42 mg/L for carbon tetrachloride, 0.11 to 1.20 mg/L for chlorogenzene, 2.03 to 68 mg/L for chlorogrorm, 3.01 to 5.56 mg/L for 1,2 dichlorobenzene, 2.54 to 34 mg/L for 1,2 dichloroethane, 13.16 to 48 mg/L for methylene chloride, 0.002 to 0.64 mg/L for nitrobenzene, 0.04 to 32 mg/L for phenol, 0.02 to 0.85 mg/L for toluene, and 3.53 to 3.77 mg/L for m-xylene. The species which exhibited the greatest susceptibility to organic compounds were the rainbow trout, Rana pipiens, and Rana temporaria. The more sensitive amphibian species generally were those which normally are restricted to aquatic or moist terrestrial habitats, whereas the more tolerant amphibians included those semi-aquatic and terrestrial species which appear to be more broadly adapted ecologically. Of the 11 test compounds, nitrobenzene, toluene, chlorobenzene, and phenol were the most toxic. The least toxic organics included dicloroethane and methylene chloride. For three chlorinated alkanes, including methylene chloride, chloroform, and carbin tetrachloride toxicity was found to increase with the degree of chlorination.
W82-05283

ACID PRECIPITATION IN THE WASHINGTON CASCADES,
Central Washington Univ., Ellensburg. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-05287

THE EFFECTS OF LAND-CLEARING ON A SMALL WATERSHED IN SOUTHERN GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
C. P. Neubauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224783, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 24, August 1981. 56 p, 13 Fig, 3 Tab, 87 Ref. OWRT A-018-GUAM(1), 14-34-0001-0112.

Descriptors: *Land clearing, *Guam, *Small watersheds, *Limnology, *Ecological effects, Watersheds, Aquatic environment, Environmental effects, Water quality, Clear-cutting, Soil temperature, Air temperature, Water temperature, Conductivity, Hardness, Hydrogen ion concentration, Phosphorus, Orthophosphates, Runoff.

A study of the limnology and aquatic ecology of a small watershed in southern Guam showed that land-clearing had pronounced effects when compared to that of an upstream control area. While no significant differences were observed in nitrate concentrations and turbidity between stations, significant mean differences were observed in the watershed in soil temperatures (0.7 degrees greater), maximum air and water temperatures (1.4 degrees less), minimum water temperature (2.0 degrees higher), conductivity (11.0 micro-mhos/sq cm less), hardness (9.0 mg/l less), pH (0.22 pH units greater), and in total phosphorus and orthophosphate concentrations (8.15 and 1.64 micrograms/1 less, respectively). Savanna vegetation repopulated the perturbed ravine forest watershed, and thus appeared to be an earlier stage of succession than the ravine forest. Fire or continued clear-cutting would set back succession and maintain savanna vegetation in the watershed. Clear-cutting increases water loss and may accentuate droughts and flooding. In addition, increased temperatures and nutrient losses from the land may cause algal blooms in the downstream areas, and nutrient losses may be long-term problems. (Zielinski-MAXIMA)
W82-05303

LIFE HISTORY AND HABITAT UTILIZATION OF CUTTHROAT TROUT (SALMO CLARKI) IN A HEADWATER STREAM ON THE OLYMPIC PENINSULA, WASHINGTON,
J. A. June.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224817, Price codes: A07 in paper copy, A01 in microfiche. M.S. Thesis, June, 1981. 116 p, 22 Fig, 31 Tab, 95 Ref, 1 Append. OWRT A-101-WASH(1).

Descriptors: *Trout, *Life history studies, Aquatic habitats, Coastal streams, *Land clearing, *Probabilistic process, Fish migration, Growth, Fish populations, Life cycles, Headwaters, Streams, Coastal waters, Canopy, Environmental effects, Probability distribution, Mathematical studies, Model studies, Computer models, *Bear Creek, *Washington, Baseline studies.

A study of the life history and habitat utilization of cutthroat trout in Bear Creek, Washington, provided baseline information for a timber removal study. Trout life history information included upstream adult spawning migration, spawning, incubation and emergence, population dynamics, and movement. Trout habitat utilization study included quantifying the Bear Creek habitat, calculating probability-of-use curves by trout life stage for certain habitat parameters, and combining the two in a habitat utilization model that calculated quality of habitat indexes. The indexes were correlated with biological measurements taken in the same sections. Significant positive correlations were found between the mean length and weight of adult trout and the quality of the indexes. Depth, velocity, and instream cover proved to be the most important of six parameters measured in relation to trout biomass and density. While there were differences in timing of spawning of resident and sea-run cutthroat trout, life history characteristics of both sea-run and resident cutthroat trout in Bear Creek were similar to those reported for other Pacific Northwest streams. The effects of timber canopy removal on density and growth of Bear Creek trout would have to be considerable to be distinguished from the effects caused by variable trout recruitment. (Zielinski-MAXIMA)
W82-05306

SOME FEATURES OF THE TOXIC ACTION OF THE NON-IONIC SURFACTANT LAUROX-9 ON DAPHNIA MAGNA,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
E. P. Shcherban.
Hydrobiological Journal, Vol 16, No 5, p 83-86, 1980. 1 Fig, 1 Tab.

Descriptors: *Surfactants, *Daphnia, *Toxicity, Water pollution effects, Crustaceans, *Laurox-9, Nonionic surfactants, Detergents, Organic compounds, Invertebrates, Eggs, Mortality, Laboratory studies.

The chronic effects of 1, 10, and 25 mg per liter of Laurox-9, a nonionic surfactant, on Daphnia magna were determined for successive generation. The surfactant was toxic to the crustacea at all levels. At the highest level a large proportion of eggs were aborted or the embryos born dead. Many of the live young had morphological defects. The second generation was of low viability, and the third generation failed to reproduce. The 1 mg per liter concentration of Laurox-9 caused a one week reduction in the minimum life span with each successive generation–from 30 days for the first generation to 17 days for the third. Egg abortion in the second and third generations was 5-6 times greater than in the first generation. The second and third generations produced more, but smaller-sized, eggs than the first generation. In the fourth and subsequent generations frequent egg abortion and slow embryo development were evident. Daphnia exposed to the 10 mg per liter concentration of Laurox-9 also had egg abortions, similar in number for the first 3 generations, and nearly doubled for the fourth and fifth generations. A secondary egg batch was often produced. If the interval between batches was 1-1.5 days these secondary eggs developed faster than the first batch. If the interval was 2 days or longer, all undevel-

oped eggs and hatched young were ejected from the brood chamber. Dwarf individuals were often observed. These eventually reached normal size. (Cassar-FRC)
W82-05328

CHANGES IN THE FATNESS OF ROACH (RUTILUS RUTILUS) UNDER THE INFLUENCE OF WARM WASTE WATER FROM A DISTRICT POWER STATION,
Gosudarstvennyi Nauchno-Issledovatelskii Inst. Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR).
V. V. Baranova.
Hydrobiological Journal, Vol 16, No 5, p 61-66, 1980. 1 Tab, 21 Ref.

Descriptors: *Fish, *Thermal pollution, *Lipids, *Roach, Heated water, *Water pollution effects, Seasonal variation, Powerplants, *Ivan'kovo Reservoir, *USSR.

Lipid contents of roach tissues (dorsal muscles, liver, gut, and gonads) were determined in populations exposed to thermal effluent from a power station in Ivan'kovo Reservoir during 1973-75. Water temperature was higher in the thermal discharge region by 11.2C in winter, 7.8C in summer, and 8.8C in autumn. Lipid contents of the tissues followed similar seasonal patterns in both warm water and control groups. The two groups of fish showed no differences in lipid content of muscles (range 2.78-6.55%). However, during summer and autumn the livers, gut, and gonads from the warm water fish were higher in lipid content than organs from the control fish. (Cassar-FRC)
W82-05330

ENZYME ACTIVITY AND KINETICS IN SUBSTRATE-AMENDED RIVER SEDIMENTS,
Sheffield University (England) Dept. of Microbiology.
J. E. Duddridge, and M. Wainwright.
Water Research, Vol 16, No 3, p 329-334, March, 1982. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Enzymes, *Sediments, Rivers, Sedimention, Mathematical equations, Michaelis-Menten equation, Amylase, Cellulase, Urease, Kinetics, *Heavy metals, *Enviromental effects, *Microbiological studies, England.

This paper reports studies to develop assays to measure amylase, cellulase and urease activity in substrate-amended river sediments, and to determine whether activity follows Michaelis-Menten kinetics. Sediments were sampled from four English rivers. The pH optimum for amylase activity was between 5.9 and 6.2 Linear relationships between amylase activity, length of incubation up to to 8 hr and sediment concentration up to 10 ml were demonstrated. The temperature optimum for amylase activity in all sediments was between 45 and 55 degrees C. Optimum pH for cellulase activity in the sediments ranged from 5.6 to 6.8. In all sediments cellulase activity showed a linear increase time and sediment concentration up to 10 ml. Optimum temperature for activity was between 37 and 44 degrees C, and the enzyme was denatured above 55 degrees C. Optimum pH for urease activity in all four sediments was in the range 7.1-7.4. Linear relationships between urease activity and incubation time up to 8 hr and sediment concentration up to 10 ml were established. Enzyme activity was inherently low in the sediments studied, but increased markedly on the addition of substrate, approximating the situation where starch, cellulase and urea enter the sediments as pollutants or from natural sources. Sediment enzyme activity generally obeyed Michaelis-Menten kinetics, but of the three enzymes, urease gave least significant correlation coefficients when the data for substrate concentration versus activity was applied to the Eadie-Hofstee transformation of the Michaelis-Menten equation. (Baker-FRC)
W82-05336

BIOLOGICAL MONITORING, PART IV - TOXICITY TESTING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. L. Buikema, Jr., B. R. Niederlehner, and J. K. Cairns, Jr.
Water Research, Vol 16, No 3, p 239-262, March, 1982. 8 Fig, 2 Tab, 146 Ref.

Descriptors: *Toxicity, *Testing procedures, Monitoring, *Bioindicators, Fish, Reviews, Water quality, Water pollution control, Pollution effects, Aquatic life.

The review describes the most common toxicity tests as they are currently carried out for the purpose of managing pollution in the environment. The type of information provided by each type of test is described, along with various attempts made to apply this information in environmental management schemes. Most toxicity tests have evaluated the short-term lethality of wastes to adult fish. Fish have been the most popular test organism, as they are presumed to be the best understood organism in the aquatic environment and perceived as most valuable by the majority of laymen. Acute toxicity tests are described from the viewpoint of the format of a test, specific considerations in test design, and the use of controls. Data collected from these tests are considered in relation to the response curve, the calculation of the median lethal dose and fiducial limits, comparisons of acute toxicity, and test standardization, Consideration is also given to the sublethal chronic test, deriving safe concentrations, and the application of toxicity test data in environmental management. In spite of increased sophistication in toxicity test methods, increased awareness of the variety of processes operating in a natural system, and the integration of information from a system of tests in various hazard evaluation protocols, the ultimate question of what is an acceptable concentration of a chemical ascertained with a known degree of accuracy is still unanswered. Research is needed on the development and validation of prediction strategies rather than the development of new toxicity tests. (Baker-FRC)
W82-05339

BIOLOGICAL MONITORING. PART V - PREFERENCE AND AVOIDANCE STUDIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. S. Cherry, and J. Cairns, Jr.
Water Research, Vol 16, No 3, p 263-301, March, 1982. 4 Fig, 7 Tab, 303 Ref.

Descriptors: *Reviews, *Bioindicators, Monitoring, *Temperature effects, Heated water, Plumes, Water quality, Chlorine, Environmental effects.

Preference and avoidance studies can be used to determine if fish or other aquatic organisms that are mobile will avoid plumes of toxic materials, whether a thermal plume or other water discharge causing no adverse biological effects will nevertheless alter the distribution of aquatic life, and whether prior conditions to which organisms have been accustomed tend to alter the preference-avoidance response, and can compare preference and avoidance data of fish to the lethal thresholds of elevated temperature and chemical effluents. Various methodologies are reviewed, including temperature preference studies, chemical avoidance studies, and temperature and chlorine avoidance tests. A ranking of final temperature preferenda by fish families is tabulated, and the relationships, between preference, avoidance, and lethal temperatures are considered. Consideration is also given to the correspondence between behavioral responses in laboratory and field thermal chlorinated effluents. (Baker-FRC)
W82-05340

THE CONTINUING STRUGGLE OF WATERBORNE ILLNESS,
E. W. Taylor.
Aqua, No 1, p 12-14,15, 1982.

Descriptors: *Public health, *Water quality, *Pathogens, Water treatment, *History, *Waterborne diseases, Drinking water, Diseases, Water pollution effects, Bacteria.

A pioneer in the fight against waterborne diseases was a London medical practitioner, Dr. John Snow, who established a connection between cholera epidemics and water supplies in the 1850's, more than 20 years before the discovery of bacteria. Other important investigators in this field were Robert Koch, who identified the causative agent of cholera in 1882, and Percy Franklin, who demonstrated the concept of fecal bacteria as indicators of sewage pollution. Waterborne diseases are still problems in subtropical and tropical areas and among visitors returning from these areas. Cholera, typhoid fever, Salmonellosis, infectious hepatitis, guinea worm, and bilharzia occur to varying degrees in both undeveloped and developed countries. Many types of water treatment are available to combat these diseases. Direct abstraction of river water with chlorination, coagulation, rapid filtration, etc. is less reliable than slower, self-purification methods. Sometimes only a few hours elapse between abstraction and consumption, allowing little time to correct quality problems. Additional disadvantages of abstracting water from rivers are the presence of small aquatic animals and ova in the distribution system and the formation of trihalomethanes from organic matter. The modern view is that water must be safe and attractive to drink (free from visible suspended matter, color, tastes, smells, undesirable bacteria, and all substances hazardous to health) and not corrosive to metals. (Cassar-FRC)
W82-05366

CHRONIC EFFECTS OF AMMONIA-STRIPPED OIL SHALE RETORT WATER ON FISHES, BIRDS, AND MAMMALS,
Colorado State Univ., Fort Collins. Dept. of Fishery and Wildlife Biology.
R. R. Nystrom, and G. Post.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 271-276, March, 1982. 2 Tab, 9 Ref.

Descriptors: *Fish, *Wildlife, *Oil shale, *Water pollution effects, Birds, Hamsters, Trout, Fathead minnows, Quail, Ammonia, Industrial wastewater, Mine wastes, Toxicity, Environmental effects, Ecological effects, *Oil shale mining.

The effects of chronic low-level exposure of fish and wildlife to ammonia-stripped oil shale retort water (SRW) were investigated using rainbow trout (Salmo gairdneri Richardson), fathead minnows (Pimephales promelas Rafinesque), coturnix quail (Coturnix coturnix Temminck and Schlegel), and golden hamsters (Mesocricetus auratus Water). Some parameters of SRW were: total Kjeldahl nitrogen, 1180 mg per liter; phenols, 47 mg per liter; conductivity, 13,000 micromhos per cm; and ammonia, 1320 mg per liter. Normal activity, behavior, and appearance continued among all the animals exposed for 10 months to SRW at the following concentrations: trout and fathead minnows, 50 or 100 ppm in water and 10% v/w SRW in food; hamsters and quail, 25% v/v SRW in drinking water and 10% v/w SRW in food. Trout showed mortalities of 85% at the 250 ppm level and 100% at 125 ppm. Examination of liver, kidney, spleen, pancreas, intestine, and other tissues revealed no pathological changes attributed to exposure to SRW. (Cassar-FRC)
W82-05375

KRAFT PULP MILL EFFLUENT COMPONENTS CAUSE LIVER DYSFUNCTION IN TROUT,
Helsinki Univ. (Finland). Dept. of Zoology.
A. O. J. Oikari, and T. Nakari.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 266-270, March, 1982. 1 Tab, 22 Ref.

Descriptors: *Fish, *Toxicity, *Pulp and paper industry, Bioassay, Water pollution effects, *Trout, Industrial wastewater, Liver, Kraft mills, Sublethal effects.

Studies are underway to devise improved methods of ascertaining sublethal effects of pulp and paper industry discharges on aquatic life. Juvenile rainbow trout, exposed to sublethal concentrations of a

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sulfate resin soap, a substance typical of kraft mill effluents, showed evidence of liver function impairment, particularly liver glycogen depletion and UDP-glucuronyltransferase activity. Exposures were 0.3 of the 96 hour LC50 (0.53 mg) for 3 days and 0.15 of the 96 hour LC50 for 11 days. Liver gylcogen was 0.67 + or - 0.31% in the 3 day test and 0.58 + or - 0.34% in the 11 day test, compared with 2.06 + or - 0.54% in the unexposed control fish. Liver UPD-glucuronyltransferase values (in micrograms per g protein) were: control, 223 + or - 18; 3-day test, 160 + or - 19; and 11-day test, 134 + or - 13. There were also significant increases in % of liver somatic index, plasma ammonia, and plasma total bilirubin and a decrease in plasma glucose in fish exposed for 11 days. (Cassar-FRC)
W82-05377

BENTHOS INVESTIGATIONS: SEDIMENT BOXES OR NATURAL BOTTOM,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint, T. W. Duke, and R. D. Kalke.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 257-265, March, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Benthic fauna, *Species composition, *Sediments, Invertebrates, Aquatic animals, Bottom sediments, *Estuarine environment, Experimental design.

The differences in benthic community structure between the natural marine bottom and sediment boxes colonized with fauna under both field and laboratory conditions were studied from December 5, 1979, to February 4, 1980. Cluster analysis of species list for the 3 types of samples suggested that laboratory-colonized sediments had a patchier distribution of species than field-colonized sediments or natural estuarine bottom sediments. According to inverse cluster analysis the dominant fauna were similar in all 3 groups. However, the species assemblage of the laboratory-colonized group was otherwise very different from the other 2 groups. Total biomass and density of the dominant organisms, Abra aequalis, per 0.18 sq m sediment box were 25.4 grams and 42,900 individuals (average weight 0.6 mg) in the field-colonized sediments, 2.3 grams and 1461 individuals (average weight 1.6 mg) in the natural bottom sediments, and 3.5 grams and about 1250 individuals in the laboratory colonized sediments. Natural bottom samples had larger individuals than the colonized communities. The large numbers of small Abra aequalis in the field boxes were probably artifacts of the phase of colonization and reproductive cycle. The field-colonized communities would probably stabilize and approach the size and composition of the natural community after a longer period. The field-colonized sediment boxes were a better alternative than laboratory-colonized boxes for studying natural benthic communities. (Cassar-FRC)
W82-05378

THE EFFECT OF PHOSPHORUS LIMITATION ON ALGAL GROWTH RATES: EVIDENCE FROM ALKALINE PHOSPHATASE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. E. H. Smith, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1421-1427, November, 1981. 7 Fig, 1 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Growth rates, Nutrients, Phosphates, Enzymes, Lake Memphremagog, Eutrophication, Metabolism, *Limiting nutrients, Effects, Indicators, Canada.

Alkaline phosphatase (APA) is an enzyme induced by phosphorus limitation in many phytoplankton species and is quantitatively related to phosphorus-limited growth in some species. Previous studies have shown the APA correlates with other signs of phosphorus shortage in several lakes and have defined APA values characteristic of severe, mild, and no limitation. The development of APA in continuous flow cultures of natural freshwater phytoplankton communities was studied to further quantify phosphorus limitation of phytoplankton growth in situ. Natural phytoplankton communities from oligothrophic-eutrophic Lake Memphremagog were grown at phosphorus-limited rates of 0.06 to 0.03 per day. APA was found to vary inversely with phosphorus-limited growth rate and to be generally uninfluenced by the community composition changes that occurred in culture. The average in situ APA in Lake Memphremagog during the ice-free season was lower than that of cultures and suggested that phosphorus-limited growth rates were greater than 0.6 per day in even the most oligotrophic sections of the lake. Algal abundance varies with total phosphorus in most north-temperate zone lakes, including Lake Memphremagog. However, data from these tests show that average community growth rates are normally high and change relatively little over a fourfold range of total phosphorus concentration. (Carroll-FRC)
W82-05380

FISH ABUNDANCE AND DISTRIBUTION NEAR THREE HEATED EFFLUENTS TO LAKE MICHIGAN,
Argonne National Lab., IL.
S. A. Spigarelli, R. M. Goldstein, W. Prepejchal, and M. M. Thommes.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 2, p 305-315, February, 1982. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Thermal pollution, *Nuclear powerplants, *Fish populations, *Ecological effects, Plumes, Lakes, Water pollution effects, Heated water, Powerplants, Electric powerplants, Environmental effects, Seasonal variation, Thermal water, Water temperature, Effluents, *Lake Michigan.

The abundance and distribution of fish with depth and temperature in locally heated and unheated sections of Lake Michigan were examined by a combined echo location-temperature mapping procedure. Measurements were taken between April and October at two adjacent powerplants in the southern basin and at one plant in the northern basin. Seasonal variations in fish densities were found in both plume and reference areas. The greatest plume densities were recorded in late spring, when alewife were spawning inshore. High fish densities were consistently noted downstream of the interfaces between ambient shore-parallel currents and discharge flows. At canal discharges, fish tended to congregate inshore, while at the offshore discharge, they congregated in deeper zones. In plume areas, fish tended to occupy shallower depth strata, which were 1-3 degrees higher than the maximum ambient temperatures. A positive correlation between fish density and increasing temperature was generally observed at both plume and reference stations during all three seasons studied. (Geiger-FRC)
W82-05383

EFFECTS OF TREATED MUNICIPAL WASTEWATER ON THE HEPATIC, XENOBIOTIC, AND STEROID METABOLISM IN TROUT,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
L. Forlin, and T. Hansson.
Ecotoxicology and Environmental Safety, Vol 6, No 1, p 41-48, 1982. 3 Tab, 37 Ref.

Descriptors: *Fish, *Wastewater, *Metabolism, Water pollution effects, *Trout, Enzymes, Liver, Steroids, Polyaromatic hydrocarbons, Oil pollution, Organic compounds, Mixed function oxidase, *Bioassay, Laboratory studies, *Treated municipal wastewater.

The effects of treated municipal wastewater on liver microsomal in vitro metabolism of 4-androstene-3,17-dione, benzo(a) pyrene, ethylmorphine, and p-nitroanisole were studied in rainbow trout (Salmo gairdneri). Fish were exposed for 2 weeks to two effluent: tap water ratios, 1:5 (Group B) and 1:1 (Group C). Group B fish showed significant increases in NADPH cytochrome c reductase on a liver weight basis. Group C showed significant increases in cytochrome P-450, NADPH cytochrome c reductase, and microsomal protein on a liver weight basis, but not on a protein weight basis, and an increase in liver somatic index. In vitro incubation of liver tissue from effluent-exposed fish with benzo(a)pyrene, ethylmorphine, and p-nitro-anisole produced increases in p-nitroanisole o-demethylase and benzopyrene hydroxylase activities and decreases in ethylmorphine N-demethylase activity. Fish exposed to effluent showed altered liver microsomal metabolism of androstenedione; 6-beta-hydroxylase activity was decreased, 17-hydroxysteriod oxidoreductase activity was increased, and 5-alpha reductase activity was not changed. Although the in vivo effects cannot be predicted, it is possible that production of mutagens and carcinogens may be increased and distrubances in the endocrine system may occur. (Cassar-FRC)
W82-05406

THE ROLE OF AGRICULTURAL SEDIMENTS AND CHEMICALS IN EUTROPHICATION,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 2H.
W82-05447

GEOCHEMICAL ENVIRONMENTS AND THE GEOGRAPHICAL DISTRIBUTION OF SOME DISEASES IN SRI LANKA,
Sri Lanka Univ., Peradeniya. Dept. of Geology.
C. B. Dissanayake, and A. Senaratne.
Water, Air, and Soil Pollution, Vol 17, No 1, p 17-28, 1982. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Fluorides, *Human diseases, *Water quality, Cancer, Chemical composition, Environmental effects, Sri Lanka, Geography, Well water, Geochemistry.

The incidence of dental disease and the distribution of fluoride in drinking water wells in Sri Lanka was investigated. Dental fluorosis and caries and the total incidence of cancer were studied. Fluoride ions were measured with the Orion ion specific electrode. The central hill country and the southwest coastal regions were relatively free of fluoride. The lowland dry zone contained a higher amount of fluoride in the water, with areas around Eppawala in the North Central Province, Maha Oya in the Eastern Province and Uda Walawe in the Southern Province showing anomalously high fluoride concentrations. Areas of high fluoride content showed a higher dental fluorosis, whereas individuals living in low fluoride regions suffered from dental caries. The intensity of rainfall is a major factor in the geographical distribution of fluoride in well water, but the natural geological factors are also significant. A proportional increase of fluoride with water hardness was noted, reflecting the geochemical status of ions in the rocks and minerals of the area. In studying the variation of the total cancer rates with the total dissolved solids in the water and the hardness of the water in the nine provinces of Sri Lanka, it became apparent that even though the curves for total solids and hardness against cancer incidence appear to be complementary, the relationship is not a simple one and there is an optimum level of hardness and total solids that corresponds to a minimum incidence of cancer. The complementary association of environmental factors such as rainfall, dissolved ions and water hardness with the incidence of cancer points to the use of goechemical correlative factors as a guide in the delineation of disease areas. (Baker-FRC)
W82-05463

INVESTIGATIONS INTO THE PROTECTIVE EFFECT OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
R. LaBelle, and C. P. Gerba.
Water Research, Vol 16, No 4, p 469-478, April, 1982. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Coastal waters, *Enteroviruses, *Adsorption, *Marine sediments, *Fate of pollut-

ants, *Water pollution sources, Bacteria, Bacteriophage, Bioindicators, Estuaries, Biological magnification, Viruses, Sediments, Pathogens.

Contamination of coastal waters with human pathogens can lead to the elimination of these resources from human use. Viruses can be bioaccumulated in filter-feeding shellfish and cause epidemics of hepatitis and gastrointestinal diseases. The adsorption of enteric viruses to estuarine sediments helps to prolong their survival in marine waters. Studies were carried out to ascertain whether sediment protects viruses from any one specific inactivating factor. The properties of sediment responsible for such protection were also investigated. Laboratory tests showed that sediment protected poliovirus 1 (strain LSc) from inactivation by microorganisms, salts, and heat. Anaerobic conditions did not affect virus survival. Bacteria nutrients increased virus survival, probably by enhancing the number of bacteria available for virus adsorption. The presence of natural organic matter did not enhance virus survival in sea-water. (Geiger-FRC)
W82-05485

INDOLES IN THE DECOMPOSITION PRODUCTS OF CERTAIN BLUE-GREEN ALGAE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W82-05505

RELATIONSHIP BETWEEN THE DISTRIBUTION OF PHOSPHORUS COMPOUNDS IN THE TISSUES OF THE BIVALVE ANODONTA CYGNEA AND ENVIRONMENTAL PHOSPHORUS LEVEL,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. D. Solomatina.
Hydrobiological Journal, Vol 17, No 1, p 54-59, 1981. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Phosphorus, *Aquatic environment, Chemical reactions, Environment, Mollusks, Water pollution effects, Metabolism.

The effect of an increased level of inorganic phosphorus in water on some of the indices of phosphorus metabolism in bivalve tissues was investigated. Experiments were conducted in aquaria on tissues of the bivalve Anodonta cygnea. Phosphorus content in the control aquarium was 0.06 mg/liter. An increased phosphorus concentration in the experimental aquaria was created by adding suitable amounts of disodium phosphate. The experiments showed that an increase in the lovel of phosphorus in the water appreciably influenced its entry into the organism of the mollusks and its distribution therein. A typical tissue reaction of their glandular organs to an increase of phosphates in the water was established. Total phosphorus in the mantle of the mollusks was appreciably increased from the third day of the research, when there was 0.3 mg/liter of phosphorus in the medium. The rate of total phosphorus accululation in the mantle increased with the time spent by the mollusks in such a medium. When phosphate content in the water was increased to 0.6 mg/liter, the amount of total phosphorus in the mantle began to increase on the very first day under these conditions. An increase of organic phosphorus content in the water to an amount 5-10 times its content in natural water has an appreciable effect on the trend of bioenergetic processes in the tissues of the mollusks. This effect was most marked in the mantle. Under the influence of increased phosphorus content in the environment of the fresh water mollusks appreciable changes were noted in the enzyme activity, the nature of which was dependent on the phosphorus level in the water. (Baker-FRC)
W82-05506

CHOLINESTERASE ACTIVITY IN ESTUARINE FISHES IN THE CUMULATION OF DDT,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii
O. V. Maslova.
Hydrobiological Journal, Vol 17, No 1, p 69-72, 1981. 1 Fig, 5 Ref.

Descriptors: *Fish populations, *Water pollution effects, Pesticide toxicity, Toxicity, Rivers, Cholinesterase, Enzymes, Accumulation, Bioaccumulation.

The level of concentration of DDT and its metabolites DDD and DDE was investigated in the organs and tissues of fishes from the Danube and the Dnieper, and the functional shifts occurring during chronic intoxication by sublethal DDT concentrations were analyzed. Fish were caught during the summer months of 1978 and 1979. The indices of cholinesterase activity in the liver and brain tissues of the fishes from the Dnieper-Bug estuary were generally higher than those in fishes from the Danube delta containing large residual amounts of DDT. Cholinesterase activity of liver tissues of pike-perch yearlings from the Danube delta was significantly lower (by 36%) than activity in pike-perch yearlings from the Dnieper-Bug estuary. As regards cholinesterase activity in the blood of the fishes studied, the results indicate that this characteristic either fails to react to the presence of DDT in the fish organism, or is increased in relation to the increase in the concentration of the toxicant. Species differences in cholinesterase activity were noted. Significant age-related differences were also found in the cholinesterase activity of the organs of the fish, and also in DDT concentrations. In all the species investigated it was the brain that had the greatest cholinesterase activity, that of the liver was less, and that of the blood least. When this characteristic was compared in fishes of different trophic levels, it was noted that the cholinesterase activity of the organs and the blood of nonpredatory fishes form the two water bodies differed less than in predatory fishes. The accumulation of residual amounts of DDT and the associated reduction of cholinesterase activity are indications of possible functional disturbances to the nervous system and to metabolic processes, and overall of a reduction in the resistance of the organism to the effect of adverse environmental factors. (Baker-FRC)
W82-05507

BIOLOGICAL RESPONSES ON LAKES IN THE MOUNT ST. HELENS BLAST ZONE,
Washington Univ., Seattle. Fisheries Research Inst.
R. C. Wissmar, A. H. Devol, J. T. Staley, and J. R. Sedell.
Science, Vol 216, No 4542, p 178-181, April 9, 1982. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Lakes, *Volcanoes, *Aquatic life, Mount St. Helens, Organic matter, Air pollution, Water pollution effects, Ecological effects, Phytoplankton, Algae, Adenosine triphosphate, Bacteria, Chlorophyll a, Nutrients, Light penetration.

The biological effects in lakes impacted by the May 18, 1980, eruption of Mount St. Helens, Washington, were investigated on June 30, 1980. In Spirit Lake suspended particulate matter increased 33-fold; light extinction coefficient, 36-fold; dissolved organic matter, 48-fold; and adenosine triphosphate, 17-fold. Other lakes within the blast zone showed increases in these parameters to a varying degree. Total bacterial counts were above 1 million per ml compared with 0.1 to 0.8 million per ml in unaffected lakes. Viable bacteria were 0.02-3% of total bacteria. Total and fecal coliforms were as high as 10,000 per 100 ml in some lakes. The high levels of dissolved organic carbon, product of pyrolyzed and steam-leached vegetation and soils, provided a food source for the bacterial population. Algal concentrations were very low, most likely as a result of light limitation rather than toxicity or competition for nutrients. The biological life of the lakes may not recover until significant mineral alterations, organic degradation, and vegetation regrowth occur. (Cassar-FRC)
W82-05519

THE IMPACT OF ACIDIC PRECIPITATION AND HEAVY METALS ON SOILS IN RELATION TO FOREST ECOSYSTEMS,
Maine Univ. at Orono. Dept. of Geological Sciences.
S. A. Norton, D. W. Hanson, and R. J. Campana.
In: Proceedings of Symposium on Effects of air Pollutants on Mediterranean and Temperate Forest Ecosystems, June, 1980, Riverside, California. Report PSW-43, Forest Service, USDA, Berkeley, California. p 152-157, 3 Fig, 1 Tab, 23 Ref. OWRT A-026-ME(9), 14-31-001-4240.

Descriptors: *Acid rain, *Fallout, *Air pollution effects, *Heavy metals, *Water pollution effects, Rainfall, Air pollution, Acidic water, Accidity, Environmental effects, Water pollution effects, Pollution load, Lead, Leading, Hydrogen ion concentration, Sulfuric acid, Vegetation effects.

Acid precipitation, experimentally and empirically, accelerates podsolization and depletes nutrient pools in forest litter and shallow inorganic soils. Further, normal terrestrial cycling of metals in eastern North America and the Pacific coast States has been altered by increasing precipitation acidity. Some heavy metals (e.g., lead) accumulate to concentrations which may impede biological soil processes and inherit phosphorus (P). Other metals are being leached from soils and inherit phosphorus (P). Other metals are being leached from soils (Al, Ca, K, Mg, and Mn). It was observed that the mobilities of Fe, Zn, and P vary with site characteristics. Biological recycling of nutrients by decomposition and uptake is impeded by a lowered pH and elevated levels of toxic metals in soils. Increased nutrient leaching caused by increased hydrogen ion input, decreases the percent base saturation. Deeper rooted plants are subjected to elvated (potentially toxic) concentrations of dissolved metals (e.g., Al and Mn). The results of this work indicates that nutrient pools are decreasing in the northeast U.S., suggesting that decreases in forest productivity will occur. (Zielinski-MAXIMA)
W82-05534

THE IMPACT OF MANAGED STREAMSIDE TIMBER REMOVAL ON CUTTHROAT TROUT AND THE STREAM ECOSYSTEM,
Washington Univ., Seattle. Fisheries Research Inst.
D. J. Martin, E. O. Salo, S. T. White, J. A. June, and W. J. Foris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236530, Price codes: A05 in paper copy, A01 in microfiche. Report FRI-UW-8107, March, 1981. 65 p, 16 Fig, 4 Tab, 34 Ref. 1 Append. OWRT A-101-WASH(2), 14-34-001-0151.

Descriptors: *Trout, *Aquatic habitants, *Land clearing, *Canopy, *Coastal zone menagement, Fish migration, Growth, Fish populations, Streams, Environmental effects, Probability distribution, Mathematical studies, Model studies, Water temperature, Biomass, Stream banks, Stream degradation.

A summary of the streamside timber removal study conducted at Bear Creek is presented. In this study, the components of the stream ecosystem influenced by removal of riparian vegetation were isolated from physical disturbances (road building and log yarding) by postponing removal of fallen timber in a streamside management zone (SMZ), and by delaying watershed logging. Physical and biological parameters linked with cutthroat trout production were examined for two years (1977-78) in designated treatment and control zones. Commercially-valued timber was then carefully removed from the tratment zone in a way that assured maintenance of under-story vegetation and streambank integrity. Keg environmental parameters in the post-treatment (1979-80) and pre-treatment (1977-78) phase were intercompared. It was deduced that canopy density reduction causes quantity and quality changes for fixed energy inputs entering the stream, and stimulates can increase in the density and biomass of the fish food supply. Sclimonid biomass can be controlled by fish food availability; hence canopy density is functionally related to fish production through a food supply control mechanism. Further, riparian management is functionally related to fish population density and age structure. Proper implementation of the SMZ concept affords a useful management practice. (Zielinski-MAXIMA)
W82-05538

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CLASSIFICATION AND MANAGEMENT OF WETLANDS IN THE WESTERN KENTUCKY COAL FIELD,
Kentucky University, Lexington Water Resources Research Inst., KY.
W. J. Mitsch, and R. W. Bosserman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236639, Price codes: A05 in paper copy, A01 in microfiche. Report 131, March, 1982. 78 p, 25 Fig, 15 Tab, 66 Ref. OWRT A-086-KY(1), 14-34-0001-1119.

Descriptors: *Wetlands, *Coal mining, *Management planning, *Field tests, *Model studies, Coal mines, Strip mines, Assessments, On-site tests, Sites, Water quality, Ecological distribution, Computer models, Watersheds, Ecosystems, Mine drainage, Classification.

This initial research report of a three-year study on wetland identification and management criteria in the western Kentucky coal field focuses on four specific activities: establishment of three intensive study sites in major wetlands for identification and management impact assessment; sampling the study site to measure water quality and ecologic structure; application of a developed classification to the study sites; and development of conceptual models of the region, watersheds, and specific ecosystems, and preliminary simulations of a wetland model. The study sites are affected by mine drainage, channelization, higher water levels, oil wells, and agriculture clearing. Preliminary analysis of field surveys demonstrated that coal mining and oil extraction may affect wetlands health; drainage, logging, channelization, and impoundments have also caused significant alterations. Field measurements and conceptual models facilitated classification scheme development for the wetlands, which considers ecologic structure system hydrology, and major man-made effects. A number of water quality (e.g., pH, temperature, conductance, sulfates, turbidity) and ecologic (e.g., vegetation growth, biomass) parameters will be considered for impact assessment relative to standard values. (Zielinski-MAXIMA)
W82-05549

OIL AND GREASE IN STORMWATER RUNOFF,
California Univ., Los Angeles. Dept. of Engineering Systems.
M. K. Stenstrom, G. Silverman, T. A.
Bursztynsky, A. L. Zarzana, and S. E. Salarz.
Report, February 1982. Association of Bay Area Governments, Berkeley, California. 241 p, 41 Fig, 44 Tab, 158 Ref, 3 Append.

Descriptors: Storm water, *Storm runoff, *Urban runoff, *Oily water, *Grease, Sampling, Land use, Hydrocarbons, Chromatography, Wastewater, Oil pollution, Runoff rates, Adsorption, Rainfall-runoff relationships, Environmental effects, Path of pollutants, *San Francisco Bay, Ecological effects.

The objective of this project was to determine the environmental effects of oil and grease in urban stormwater on marine environments in San Francisco Bay and to recommend suitable control measures. Studies show that there are significant effects of low level oil/grease pollution and that continuous pollution from urban stormwater can change the ecology of a marine environment. Five field sampling stations were selected in a stormwater basis in Richmond, CA to determine oil/grease pollution by land-use type. Samples were taken from the mouth of the watershed, a parking lot, a commercial street, a residential area, and from a light industrial facility. Land-use strongly affects oil/grease in stormwater. The major contributing factor is motor vehicles. Areas with the most auto traffic had the highest concentration of oil/grease in stormwater and the highest hydrocarbon load factor. Mean oil/grease concentration in runoff flow ranged from 4.13 mg/1 in an upstream residential area to 15.25 mg/1 in a parking lot. A strong correlation exists between total rainfall and total mass of oil/grease pollution---contamination is higher at the beginning of a storm than at the end. Nine control techniques showed promise. Three non-structural techniques were to recycle used crankcase oil, reduce auto emissions through better inspections, and improve standards. Six structural techniques were to improve street/parking lot cleaning, sorption systems for manhole and gutter intakes, porous pavement, greenbelts around parking lots, dispersion devices, and wetlands or marshes to trap pollutants. These are site-specific techniques but it was recommended they be developed further. (Atkins-Omniplan)
W82-05557

THE LONG LAKE DIVERSION: AN ENVIRONMENTAL EVALUATION,
Ontario Ministry of Natural Resources, Thunder Bay.
For primary bibliographic entry see Field 6G.
W82-05568

STRUCTURAL DAMAGE TO LEAF CHLOROPLASTS OF ELODEA DENSA CAUSED BY METHYLMERCURY ACCUMULATED FROM WATER,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
D. C. Mortimer, and M. Czuba.
Ecotoxicology and Environmental Safety, Vol 6, No 2, p 193-195, 1982. 3 Fig, 4 Ref.

Descriptors: *Plant pathology, *Laboratory studies, *Organic compounds, Methylmercury, Pesticides, Water pollution effects, Industrial wastes, Environmental effects, Rivers, Ottawa, Canada, Elodea densa, Aquatic plants.

One of the effects resulting from the adbsorption of methylmercury by Elodea densa leaves is damage to chloroplast integrity. Elodea densa plants were placed in aquaria with Ottawa municipal water flowing through. Methylmercury solutions of varying strengths were added. The first stage of damage shows swollen chloroplasts with evidence of outer membrane rupture and a suggestion of internal thykaloid disturbance. The micochondria and other organelles appear intact. Second stage revealed exploded or peeled chloroplasts with the outer membrane completely gone. While the mechanism of methylmercury toxicity in the leaves is not yet understood, it is clear that individual cells have different sensitivities to methyl-mercury and that the chloroplast membrane is much more senitive than other membranes within the cell, such as mitochondrial membranes. The tissue level of methylmercury at this stage of damage was about 5 ng/g fresh weight, obtained by absorption from water containing 150 ng/liter over 25 days. With such low concentrations within the plant tissue as a whole, it has not been decided whether the chloroplast membrane is damaged by methylmercury effects acting from within the chloroplast or from the cytoplasmic side of the membrane. (Baker-FRC)
W82-05570

EFFECT OF PHENOL ON IN VIVO ACTIVITY OF TISSUE TRANSAMINASES IN THE FISH NOTOPTERUS NOTOPTERUS,
D. A. V. Coll., Muzaffarnagar (India). Dept. of Zoology.
S. R. Verma, S. Rani, and R. C. Dalela.
Ecotoxicology and Environmental Safety, Vol 6, No 2, p 171-176, 1982. 2 Tab, 25 Ref.

Descriptors: *Fish populations, *Phenols, Organic compounds, Water pollution effects, Population exposure, Enzymes, Amino acids.

This study was undertaken to investigate in vivo the chronic effects of the water-pollutant phenol on glutamic oxalacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) activity in tissues of N. notopterus. Active and healthy fish specimens were collected from freshwater resources. Groups of fish were exposed to concentrations of phenol in tap water equivalent to 1/2, 1/5, and 1/10 of the 96 hr median lethal dose. Fish were examined after 10, 20 and 30 days of exposure. Alterations were produced in activity of the transmaminases in different tissues, and the difference between control and treated fish was significant. In general, the maximum stimulation of GOT was noted in the liver. For GPT maximum stimulation occurred in the heart, reaching the highest concentration after 30 days of exposure. Minimum stimulation for both GOT and GPT was in the kidney, with the lowest concentration occurring after 10 days of exposure. The stimulation pattern was similar in most cases and was found to be dose and duration dependent. The marked stimulation of GOT and GPT activity by phenol suggests a potential for phenol to interfere with processes related to amino acid metabolism inside the fish body. (Baker-FRC)
W82-05571

FLOODWATER NUTRIENT PROCESSING IN A LOUISIANA SWAMP FOREST RECEIVING AGRICULTURAL RUNOFF,
Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
G. P. Kemp, and J. W. Day, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243304, Price codes: A05 in paper copy, A01 in microfiche. Final Report, December, 1981. 72 p, 18 Fig, 9 Tab, 85 Ref. OWRT A-043-LA(2).

Descriptors: *Louisiana, *Swamp forest, *Agricultural runoff, Overland flow, *Nutrient dynamics, Eutrophication, Nitrogen, Phosphorus, Hydrologic budget, Decomposing organic matter, Dissolved oxygen, Swamps.

From September 1978 through June 1979, experiments were carried out to: (1) measure N and P dynamics in a Louisiana swamp which receives agricultural runoff, (2) Calculate N and P budgets to determine if there was a net uptake or release, (3) Conduct laboratory experiments to determine the influence of leaf litter decomposition and dissolved oxygen nutrient retention by the swamp. A water budget was calculated as follows: input was 23% precipitation and 77% pumpage, outflows were 11% evapotranspiration and 89% drain. This water budget along with measured nutrient concenrations were used to calculate N and P budgets. Most of the input to the swamp study site (70% N, 74% P) was pumped into the ponds as particulates. Of the total inputs only 3% N and 1% P was introduced with precipitation, however, rain accounted for 30% of the input of total inorganic N. Outflows from the swamp were 56% and 60% of total N and P inputs, respectively. Thus the swamp retained 44% N and 40% P. Most of this was in the form of particulates. The swamp removed inorganic N and exports PO4 and organic N. This is reflected in the characteristically low N:P ratio of the swamp waters. The microcosm studies indicate that dissolved oxygen concentrations are most important factor regulating swamp water chemistry. The results indicate that the swamp can serve as long-term sink for significant quantities of N and P and that burial in sediments and dentrification are mechanisms for permanent losses. (Author abstract)
W82-05622

HISTOPATHOLOGICAL CHANGES IN THE LIVER AND BRAIN OF FISH EXPOSED TO ENDOSULFAN INSECTICIDE DURING TSETSE FLY CONTROL OPERATIONS IN BOTSWANA,
Centre for Overseas Pest Research, London (England).
P. Matthiessen, and R. J. Roberts.
Journal of Fish Diseases, Vol 5, No 2, p 153-159, 1982. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Fish populations, *Insecticides *Endosulfan, *Botswana, Fish toxins, Pesticides, Sprays, Spraying, Water pollution sources, Tsetse fly control.

This study was made to determine whether the tsetse control campaign in the Okavango Delta produced significant histopathological changes in exposed fish, and if so, how quickly they recovered after spraying. Studies were confined to liver and brain. Several herbivorous and carnivorous species were investigated, but detailed discussion was limited to Clarias gariepinus and Tilapia rendalli. The histopathological changes were placed in the context of simultaneous observations that were

being made of fish activity and reproductive behavior. Samples were gathered throughout the 1978 spraying season and during the ensuing 7 months. All sampled fish were apparently healthy, and none were taken from locations where fish kills were noted. All species studied contained histological lesions during the spraying season which were distinguishable from the normal background disease pattern and indicative of pesticide induced damage. Lesions in the piscivore Hepsetus odoe were relatively mild, whereas those in the omnivorous Clarias gariepinus and herbivorous Tilapia rendalli were more serious. There is little doubt that the pathological changes were caused by endosulfan. Liver damage in C. gariepinus was severe, especially in the peribiliary tissue. Accumulations of large amounts of lipid were noted in poisoned tissue, and a disappearance of melanomacrophage centers from C. gariepinus liver was observed Pathological changes in T. rendalli brain clearly show that endosulfan has neurotoxic effects. (Baker-FRC)
W82-05630

PRELIMINARY INVESTIGATION OF THE ALGAL FLORA IN THE SEDIMENTS OF LAKE ERIE,
State Univ., of New York Coll. at Buffalo. Great Lakes Lab.
V. R. Frederick.
Journal of Great Lakes Research, Vol 7, No 4, p 404-408, 1981. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Sediments, *Algal growth, Eutrophication, *Lake Erie, Great Lakes, *Diatoms, *Lake sediments.

A preliminary examination was performed regarding the extent of the diatom floras in the sediments of Lake Erie and their applicability in providing a better understanding of the process of natural and cultural eutrophication in the Great Lakes. The non-diatom algal flora in the sediments was also investigated. A 45-cm long core was obtained from a site in the eastern basin of Lake Erie. Asterionella formosa, Melosira islandica, M. italica, Stephanodiscus niagarae, and Tabellaria fenestrata were the most abundant diatoms encountered in the core sample. Thirteen non-diatom algal taxa were identified in the 13 sediment samples. Forty diatom taxa were identified in the sediments of this study. Centric and araphidinate diatoms dominated the flora at all sediment levels. Quantitative diatom profiles and relative abundance profiles each provide a contrasting history of post settlement Lake Erie. In view of the known history of the lake, the relative frequency profiles appear to be most applicable. The C/P index of trophic status and the diatom diversity support those profile. (BAker-FRC)
W82-05633

WATER TEMPERATURES IN NANTICOKE-LONG POINT BAY REGION OF LAKE ERIE,
Ontario Hydro, Toronto. Hydraulic Studies and Development Dept.
R. S. Arden, and R. Farooqui.
Journal of Great Lakes Research, Vol 7, No 4, p 337-344, 1981. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Water temperature, *Electric power industry, *Lake Erie, Lakes, *Thermal pollution, Heated water, Thermal powerplants, Thermal power.

A summary of continuous temperature data and an analysis of results obtained from temperature measurements taken near the Nanticoke Thermal Generating Station during May to November of 1970-1979 are presented. Although temperatures varied from year to year, generally similar temperatures were recorded at all shore-based stations, with slightly higher temperatures being recorded at Peacock Point during both pre-operational and post-operational years of the power plant. The monthly mean water temperatures at 2 meter depths were generally in step with the air temperature. During the spring, water temperature did not keep pace with changes in air temperature, sometimes varying by as much as 8-10 degrees C. Maximum monthly and daily mean temperatures recorded a the tower location in the Outfall Bay were about 1 degree higher than the nearshore locations during the summer months of 1975 and 1976. This may be attributed in part to the influence of the thermal effluent from Nanticoke GS, as the average plant output for July to September was highest during those years. During the summer and fall large water temperature changes occurred in the Nanticoke-Long Point Bay Region in both pre-operational and post-operational phases of the Nanticoke Generating Station. With the exception of the Outfall Bay location, which had slightly elevated temperatures during 1975 and 1976, the operation of the Nanticoke Generating Station had essentially no effect on the temperature regime of this area. (Baker-FRC)
W82-05637

MODELING OF PHYTOPLANKTON-NUTRIENT DYNAMICS IN SAGINAW BAY, LAKE HURON,
Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
V. J. Bierman, and D. M. Dolan.
Journal of Great Lakes Research, Vol 7, No 4, p 409-439, 1981. 15 Fig, 6 Tab, 48 Ref.

Descriptors: *Phytoplankton, Nutrients, *Lake Huron, *Saginaw Bay, Lakes, *Nutrient dynamics, Great Lakes, Model studies, Phosphorus, Silicon, Plankton, Nitrogen.

A study was conducted to gain insight into the physical, chemical, and biological processes affecting phytoplankton growth and to use the model as a tool for comparing future effects of various waste water management strategies. The multi-class phytoplankton simulation model was set to field data acquired on Saginaw Bay, Lake Huron, during 1974. The concept of a single limiting factor for phytoplankton growth was found to be overly simplistic. Results indicated that temperature and light were relatively more growth rate limiting than nutrients on an annual average bases. However, as a consequence of nutrient depletion, nutrients became relatively more important at the times of peak phytoplankton crops. Nitrogen was more growth rate limiting than phosphorus to the total phytoplankton crop, although important differences occurred among the individual functional groups. While nitrogen and silicon were important in phytoplankton-nutrient dynamics, the supply of phosphorus would ultimately determine the size of the blue-green component of the total crop because nitrogen fixing blue-greens did not have absolute requirements for dissolved available nitrogen or silicon. Phosphorus requirements for summer crops were satisfied by recycle processes within the water column. Phytoplankton production was extremely sensitive to variation in the light extinction coefficient in the water column and relatively insensitive to variations in incident solar radiation. (Baker-FRC)
W82-05639

ESTIMATION OF ORGANIC COMPOUND EMISSIONS FROM WASTE LAGOONS,
New York State Dept. of Environmental Conservation, Albany.
T. T. Shen.
Journal of the Air Pollution Control Association, Vol 32, No 1, p 79-82, January, 1982. 1 Tab, 14 Ref.

Descriptors: *Waste disposal, *Air pollution, Organic compounds, Hazardous wastes, Environmental effects, Air pollution effects, Volatility, Lagoons, Wastewater lagoons, Ponds.

A method is described for the estimation of organic compound emissions from waste lagoons. The method is based on the best information currently available and offers a simple technique for estimating the volatilization rate of volatile organics from these lagoons. The volatilization rates depend on meteorological conditions occurring at the gas-liquid interface, which may vary appreciably with time. Thus only short-term emission rates can be used for estimation. The rates are also greatly influenced by the presence of surface materials such as floating solids and/or liquids. Based on the illustrative examples given and other calculations, it appears logical to conclude that for most air contaminants of environmental concern, the liquid phase mass transfer coefficient controls the rate of volatile organic compound emissions from waste lagoons, and the gas phase mass transfer coefficient has insignificant effects on the calculation of the overall mass transfer coefficient. The gas phase mass transfer coefficient can be influenced greatly by turbulence and surface films; these effects are not included in the equations. The method as presented becomes fairly simple and straightforward, but it should be used with care and discretion and with a good knowledge of the waste composition and the prevailing physical situation of the waste lagoon. (Baker-FRC).
W82-05679

ELECTRICAL INTERACTION BETWEEN POLARIZED WATER MASSES AND ZOOPLANKTON IN WATER BODIES,
Akademiya Nauk SSSR Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 5G.
W82-05707

EFFECTS OF SELECTED ORGANIC COMPOUNDS ON RADIONUCLIDE ADSORPTION TO SEDIMENTS IN FRESHWATER SYSTEMS,
Washington Univ., Seattle. Coll. of Ocean and Fisheries Sciences.
J. R. Clayton, Jr., T. H. Sibley, and W. R. Schell.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 409-415, 1982. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Radioisotopes, *Adsorption, *Sediments, *Organic compounds, Fate of pollutants, Cobalt radioisotopies, Americium radioisotopes, Rubidium radioisotopes, Cesium radioisotopes, Salicylic acid, Acetic acid, Ethylenediamine tetraacetic acid, Phenanthroline, Nitrosonaphthol.

The effects of organic compounds on radionuclide adsorption to sediments were determined using autoclaved sediments and water from Lake Washington, Washington, and Cattaraugus Creek, New York. Organic compounds, selected for the variety of functional groups available for reaction with radionuclides and sediment particles, were 1,10-phenanthroline, acetic acid, salicylic acid, and ethylenediamine-tetraacetic acid (EDTA) all at concentrations of 0.0001 M, and 1-nitroso-2-naphthol at a concentration of 0.00001M. The radionuclides were Co57, Ru106, Cs137, and Am241. Distribution coefficients (kd) were constant with increasing concentrations of EDTA for Ru106 or Cs137. However, for Am241 marked decreases in distribution coefficients occurred at EDTA concentrations of 0.0001 to 0.000001M, a result of the formation of soluble EDTA-Am241 complexes. Statistically significant differences were obtained for Kd values and Am241, Co57, and Ru106 but not for Cs137. Co57 and Am241 Kd were much higher with acetic acid, and lower for EDTA. For Ru106, 1-nitroso-2-naphthol,1,10-phenanthroline, acetic acid, and EDTA all produced higher Kd values than controls, Salicylic acid did not significantly change Kd values for any of the radionuclides tested. The complex variety of interacting factors shows the necessity of characterizing water and sediment chemical parameters in adsorption studies. (Cassar-FRC)
W82-05724

MUTAGENIC POTENTIAL OF WATER CONCENTRATES FROM THE EFFLUENT OF A WASTE OIL STORAGE POND,
Texas A and M Univ., College Station. Dept. of Soil and Crop Science.
K. W. Brown, and K. C. Donnelly.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 424-429, 1982. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Mutagens, *Oil wastes, *Chlorinated hydrocarbons, Water pollution effects, Carcinogens, Pesticides, Polychlorinated biphenyls, Hexachlorobenzene, Indicators, Bioindicators, Bioassay.

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Water samples collected before and after dredging a waste oil storage pond were analyzed by two systems capable of detecting mutagens and carcinogens: the Ames Salmonella/microsome assay and the Bacillus subtilis DNA repair assay. In the Salmonella test bactericidal effects on all strains were observed at doses equivalent to 140 ml of unconcentrated effluent. Although the post-dredging sample produced slight increases in the mutation frequency of strain TA98 at lower dose levels, there was no dose response effect. The pre-dredging sample results were inconclusive. The DNA repair assay showed the presence of DNA damaging agents at a dose equivalent to 400 ml per plate in pre-dredging samples. In the post-dredging sample there was a substantial reduction in capacity to produce repairable DNA damage. Chemical analysis of the oil waste water determined that hexachlorobenzene and polychlorinated biphenyls were present at trace levels in the pre-dredging samples but were undetectable in the post-dredging sample. (Cassar-FRC)
W82-05727

A SENSITIVITY AND ERROR ANALYSIS FRAMEWORK FOR LAKE EUTROPHICATION MODELING,
W. W. Walker.
Water Resources Bulletin, Vol 18, No 1, p 53-60, February, 1982. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Eutrophication, *Lakes, *Mathematical models, Water quality, *Error analysis, *Sensitivity analysis, *Simulation analysis, Watersheds, Phosphorus, Chlorophyll A, Watershed protection, Water quality management, Lake Morey, *Vermont, Monte Carlo method.

Agencies responsible for managing lake water quality at regional levels are frequently confronted with a scarcity of information. Data limitations result in uncertainties with respect to assessment of problem conditions and priorities for further study and/or restoration. A modeling framework which permits quantitative assessment of this uncertainty in a useful and flexible manner is described and demonstrated. The Lake Eutrophication Analysis Procedure consists of a series of linked models which predict lake water quality conditions as a function of watershed land use, hydrologic variables, and morphometric variables. Sensitivity and error analysis techniques are presented which provide the user of the model or of a given model linkage with the following statistics for each predicted variable: mean, variance, confidence limits, and ranking of input variables with respect to sensitivity and contribution to prediction variance. Predicted distributions were found to compare favorably with those estimated using Mone Carlo simulation. Application of the framework to data from Lake Morey, Vermont, showed that prediction variances, attributed largely to model error, were comparable to the observed year-to-year variance in water quality, as measured by spring phosphorus concentration, hypolimnetic oxygen depletion rate, summer chlorophyll-a, and summer transparency for this lake. Use of the framework provides perspective on key assumptions and controlling factors and identifies the major sources of uncertainty in a given model application. As a result, it is possible to design effective additional monitoring and/or modelling efforts, and the probability that a significant management decision will be made with excessive confidence in the predicted outcome is reduced. (Carroll-FRC)
W82-05739

PHYTOPLANKTON RESPONSES TO GROUND WATER ADDITION IN CENTRAL FLORIDA LAKES,
Southwest Florida Water Management District, Brooksville.
P. M. Dooris, G. M. Dooris, and D. F. Martin.
Water Resources Bulletin, Vol 18, No 2, p 335-337, April, 1982. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Phytoplankton, *Bicarbonates, *Species diversity, Lakes, Water quality, Florida, Inorganic carbon, Carbon, Floridan aquifer, Pumping, Groundwater.

Phytoplankton diversity indexes were higher (especially in the wet season) in small Florida lakes augmented by groundwater pumping than in unaugmented lakes. The diversity indexes were directly correlated with inorganic carbon levels of the groundwater. As much as 549 kg of inorganic C can be added as bicarbonate to a lake, assming 7 days pumping at 2.18 million liters per day and an inorganic C concentration of 36 mg per liter in the groundwater. (Cassar-FRC)
W82-05747

DUAL OBJECTIVE CONTROL OF NUTRIENT LOADING INTO A LAKE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5G.
W82-05750

WATER QUALITY MANAGEMENT IN BRITISH COLUMBIA,
Pollution Control Board (British Columbia).
C. J. G. Mackenzie.
Canadian Water Resources Journal, Vol 5, No 3, p 69-77, 1980. 5 Ref.

Descriptors: *Canada, Water management, *Water policy, *Water quality management, *British Columbia, Water resources development, Fraser River, Okanagan River, Water pollution effects, Environmental effects, Wildlife, Fish, Recreation, Hydroelectric plants, Dams.

Water use policy in British Columbia has not been precisely enunciated. Two federal agencies with opposing interests are in charge of the Fraser River. Enhancement of the salmon fishery is not compatible with the efforts to improve navigation and port facilities on the lower river (dredging and filling of wetlands). Water quality in the Fraser and Okanagan systems is still good, but both basins are candidates for destruction as population and economic growth continues. In the Okanagan 100 years of disregard for an integrated land and water use policy have produced visible deterioration--silt in beach areas and proliferation of algae and littoral plants in lakes. Heavy metals and other pollution have been occurring with increasing frequency in the Fraser Estuary. Future water resources management will likely be in response to short-term commercial needs, with little regard for long-term implications. Even when wildlife, fish, and recreation are considered in master plans, results are often ineffective and expensive. For example, salmon ladders at the large Colorado river dams allowed adult fish to move upstream but blocked young fish from returning to the sea. It is expected that all major wild rivers in British Columbia will be tame within a generation. (Cassar-FRC)
W82-05767

VOLATILIZATION OF KETONES FROM WATER,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
R. E. Rathbun, and D. Y. Tai.
Water, Air, and Soil Pollution, Vol 17, No 3, p 281-293, 1982. 2 Fig, 6 Tab, 35 Ref.

Descriptors: *Organic compounds, *Volatility, *Mass transfer, *Ketones, Fate of pollutants, Oxygen absorption coefficient, Liquid-film coefficient, Gas-film coefficient, Kinetics, Thermodynamics, Mathematical equations, Air-water interfaces.

Mass transfer coefficients for volatilization from water were measured in a laboratory water bath simultaneously with the oxygen adsorption coefficient for several ketones: acetone, 2-butanone, 2-pentanone, 3-pentanone, 4-methyl-2-pentanone, 2-heptanone, and 2-octanone. The liquid-film and gas-film coefficients of the 2-film model were determined for the ketones from the mass transfer coefficients. The % resistance of the liquid-film ranged from 37.6% for acetone to 74.7% for 2-octanone at low mixing conditions and from 10.8% for acetone to 37.1% for 2-octanone at high mixing conditions. The liquid-film coefficients for the ketones varied with the 0.719 power of the molecular diffusion coefficient, consistent with values reported in the literature. However, the liquid-film coefficients were variably dependent on molecular weight (-0.263 power for acetone to -0.378 power for 2-octanone). This disagreed with the constant -0.500 power assumed in the literature. Gas-film coefficients were independent of molecular weight, in disagreement with the -0.500 power assumed in the literature. The reason for these discrepancies may be that the organic materials used in the present work are very soluble in water whereas previous work dealt with slightly soluble organics. (Cassar-FRC)
W82-05782

EFFECTS OF WATERHYACINTH ON THE PHYSICOCHEMISTRY OF A SOUTH GEORGIA POND,
Clemson Univ., SC. Dept. of Zoology.
S. P. Schreiner.
Journal of Aquatic Plant Management, Vol 18, p 9-12, 1980. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Herbicides, *Water hyacinth, *Water quality, Aquatic weeds, Weed control, Aquatic plants, Dissolved oxygen, Nutrients, Grassy Pond, *Georgia, Water pollution effects, Detritus, Biomass.

Water quality and water hyacinth biomass and floating detritus were determined in three areas of Grassy Pond, Georgia, 97 ha in area and 2 m deep, in the summer of 1977. The three sampling sites were: old untreated, undisturbed mat; the edge of an undisturbed mat; and in a herbicide-treated area following 6 weeks of macrophyte regrowth. Water hyacinth and floating detritus (in kg per sq m dry weight), respectively, for the three sites were: old mat, 0.99 and 1.14; mat edge, 0.83 and 0.11; and herbicide-treated mat, 0.39 and 0.03. Water below untreated plants had lower oxygen, pH, and Eh and increased C02. In herbicide-treated areas water quality was similar to that of open water except for temporary decreases in 0 and increases in C02 and nutrients produced by plant decomposition. (Cassar-FRC)
W82-05809

INHIBITION OF NITRIFICATION BY ARSENIC, CHROMIUM, AND FLUORIDE,
College of Petroleum and Mineral, Dhahran (Saudi Arabia).
S. A. Beg, R. H. Siddiqi, and S. Ilias.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 482-488, May, 1982. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Inhibition, *Nitrification, Kinetics, Water pollution effects, Toxicity, Ammonia, Oxidation, Arsenic, Fluorides, Chomium, Fewrtilizers, Industrial wastewater, Shock loads, Wastewater treatment.

The inhibitory effects of arsenic, chromium, and fluoride on the nitrification process were investigated in a packed bed fixed film biological reactor. The nitrification reaction (ammonia oxidation) was independent of residual substrate concentrations, a zero-order reaction, for the conditions of the experiment, 60 and 120 mg per liter initial concentrations of ammonia. Nitrification was inhibited by Cr, As, and F under shock load conditions. The inhibited reaction was also zero-order. The inhibitor coefficients (the concentration of inhibitor that would inhibit the reaction rate by 50%) were 50 mg per liter for Cr (most toxic), 292 mg per liter for As, and 1218 mg per liter for F. Fertilizer plant wastewater contains 0-10 mg per liter Cr, 0-20 mg per liter As, and 0-200 mg per liter F. Therefore, at the upper limits of these concentrations, the inhibitory effect would be 17%, 7%, and 14% for Cr, As, anf F, respectively. (Cassar-FRC)
W82-05855

THE PHOSPHORUS CYCLE IN GERMISTON LAKE. II. THE IN VITRO AND IN SITU ABSORPTION OF 32-P BY POTAMOGETON PECTINATUS L,

Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater biology.
J. F. Vermaak, J. H. Swanepoel, and H. J. Schoonbee.
Water S. A., Vol 8, No 1, p 52-57, January, 1982. 3 Tab, 50 Ref.

Descriptors: *Phosphorus, *Macrophytes, Absorption, Nutrients, Germinston Lake, Potamogeton pectinatus, Translocation, Lakes, Cycling nutrients.

The effect of the soluble reactive phosphorus concentration on the adborption of phosphorus by the different organs of Potaogeton pectinatus L. was investigated. The effect of a higher soluble reactive phosphorus concentration in the root compartment on the absorption, translocation, and release of phosphorus by this species was also studied. The roots of P. pectinatus absorbed P32 in situ. both the roots and foliage of this species absorbed P32 from their respective environments, and both the roots and the foliage released a small fraction of the absorbed P32 after translocation. On the basis of this study, it was decided to use the compartmentalized container method to study the uptake and release of P32 by P. pectinatus in Germinston Lake on a seasonal basis. The results of this experiment, which showed the existence of a seasonal variance in phosphorus uptake, translocation, and release, will be presented later. (Baker-FRC)
W82-05895

5D. Waste Treatment Processes

POLLUTION: CLEANING UP WITH THE WATER HYACINTH,
J. F. Schlais.
Environment, Vol 22, No 5, p 5, 43, June, 1980.

Descriptors: *Wastewater treatment, *Water hyacinth, Biological oxygen demand, Suspended solids, Nitrogen, Phosphorus, *Wastewater lagoons, *Biological wastewater treatment, Chemical recovery.

In 1976, the National Aeronautics and Space Administration's National Space Technology Laboratory in Mississippi began using water hyacinths to treat the wastewater in its sewage lagoon. This action was taken on the advice of the head of the Laboratory's Vascular Aquatic Plant Program, who had been investigating the possibility of using the plant in waste reuse and water recycling systems on manned space flights. In 3 months, the water hyacinths cut the 5-day biological oxygen demand by 95 percent to 5 milligrams per liter and the total suspended solids by 90 percent to 10 milligrams per liter. In addition, the water hyacinths reduced ammonia and organically bound nitrogen by 73 percent and phosphorus by 57 percent. Water hyacinths used to treat a second lagoon, which received wastewater from the Laboratory's large general, photographic, and pesticide laboratory complex, were found to readily absorb and concentrate in their roots such pollutants as lead, mercury, cadmium, and organic compounds suspected of being carcinogenic. Although these plants must be disposed of in a manner designed to prevent the heavy metals from leaching out, it may be possible to recover valuable metals after several years. The water hyacinth can survive temperate winters, and an enclosed greenhouse system is being developed to facilitate use of this wastewater treatment method where freezing temperatures would kill the plant. Harvested plants can be sold as cattle food supplements, for use in producing methane, or as a fertilizer for sandy soils. Although evapotranspiration rates are high, use of greenhouse covers with special drainage pipes can result in the recovery of as much as 40 percent of the daily wastewater as pure freshwater. (Carroll-FRC)
W82-04770

DISINFECTION EFFICIENCIES OF CHLORINE DIOXIDE IN A GRAVITY FLOW CONTRACTOR,
Strauss and Roberts, Porterville, CA.
K. E. Longley, B. E. Moore, and C. A. Sorber.
Journal of the Water Pollution Control Federation, vol 54, No 2, p 140-145, February, 1982. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Disinfection, *Chlorine dioxde, *Bacteria, Viruses, *Coliforms, Mixing, *Wastewater treatment, Chlorine, Chlorination, Gravity flow contractors.

Chlorine dioxide and chlorine were evaluated as disinfectants for reduction of wastewater fecal coliforms and coliphages in a gravity flow contractor. Both disinfectants produced biphasic inactivation curves with most of the inactivation occurring within the first 3 minutes. Fecal coliforms were reduced by log 1.7 and log 5.1 by initial chlorine dioxide doses of 1.0 and 10.,0 mg per liter, respectively, at 30 minutes contact time. Coliphage inactivations were log 1.4 and log 3.7 for chlorine dioxide doses of 1.0 and 10,0 mg per liter, respectively, at 30 minutes contact time. A dose of 5 mg per liter chlorine reduced fecal coliforms by log 5.1 and coliphages by log 1.7. Chlorine dioxide was superior to chlorine as a disinfectant when both concentrations were expressed in terms of chlorine. Chlorine dioxide also produced very low disinfectant residuals. (Cassar-FRC)
W82-04782

COMPUTER-BASED IMPLEMENTATION OF COMBINED SEWER CONTROL,
EMA, Inc., St. Paul, MN.
T. M. Brueck, D. F. Peterson, and J. A. Nye.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 198-205, February, 1982. 12 Fig, 2 Ref.

Descriptors: *Combined sewers, *Sewer systems, *Control systems, Computers, Automation, Storm water, *Lima, *Ohio, Gates, Overflow, Storage, *Wastewater management, Wastewater collection.

A computer-controlled combined sewer system, operating the Lima, Ohio, since the spring of 1980, has provided accurate and responsive automatic control of storage and overflows during storm events, operational ease and flexibility, and a reduction in sewer system maintenance. The original computerized system, serving an area of about 1500 ha, included eight regulator/overflow stations and an interceptor lift station. Analysis of the existing computer system by simulation and field testing resulted in a new computer control system. This allows control of sewer gates for storage equalization, measurement of river overflow, and control of river gates to protect against in-system flooding. A CRT tube displays information about the sewer system in either overview or detailed form. Three modes of control (Downstream Storage, Equal Storage, and Dewatering) are used to achieve the objectives: to minimize upstream in-system flooding, to maximize rainfall in-system storage, to equalize diurnal flow variations to the treatment plant, to minimize gate operations, and to measure overflow to the river. (Cassar-FRC)
W82-04783

RELIABILITY AND STABILITY OF TRICKLING FILTER PROCESSES,
S. Niju, E. D. Schroeder, and R. S. Haugh.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 129-134, February, 1982. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Trickling filters, *Design criteria, *Reliability, *Stability analysis, Activated sludge process, *Wastewater treatment, Model studies, Statistical analysis, Biological oxygen demand, Suspended solids.

Concentrations of BOD and suspended solids in effluents from 11 trickling filter plants were statistically analyzed. Lognormal distribution functions fit these data. Since reliability and stability models developed for the activated sludge process fit the trickling filter data well, these models may be used to design a trickling filter plant of chosen reliability or to assess the reliability and stability of an existing plant. Plants with a standard deviation of 10 g per cu m or less BOD or suspended solids generally have maximum daily concentrations of these parameters which are less then 70 g per cu m. (Cassar-FRC)
W82-04784

TREATMENT OF CYANIDE WASTE BY THE EXTENDED AERATION PROCESS,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, Jr., E. T. Gaudy, Y. J. Feng, and G. Brueggemann.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 153-164, February, 1982. 11 Fig, 1 Tab, 31 Ref.

Descriptors: *Cyanide, *Industrial wastewater, *Extended aeration, Aeration, Chemical wastewater, *Wastewater treatment, Biological treatment, Aeration, Sludge, Toxicity, Sewage bacteria, Hydrolytic assist.

Cyanide at levels of 10, 15, and 20 mg per liter was efficiently metabolized in a laboratory extended aeration process using a periodic hydrolytic assist to the autodigestive process. The hydrolytic assist controls the mixed liquor suspended solids level without wasting sludge. Steady feeding and prolonged acclimatization were necessary to achieve good efficiency and nitrification. Under these conditions cyanide was not detached in sludge or effluent. Sudden 5 mg per liter increases in cyanide concentrations produced severe upsets which required 2 to 4 weeks for recovery. The predominant organisms, Bacillus and Klebsiella, did not metabolize cyanide but survived up to concentrations of 90 mg per liter. Other cyanide-degrading organisms were present in the biomass. Experiments indicated that up to 60% of cyanide in the system was removed by stripping. This study showed that low concentrations of cyanide may be sewered to a public treatment works using the hydrolytically assisted extended aeration process without adverse effects. (Cassar-FRC)
W82-04787

EFFECT OF MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5C.
W82-04829

ADVANCED WASTEWATER TREATMENT FOR GROUNDWATER RECHARGE--BERLIN RECHARGE PROJECT (RECYCLAGE ET TRAITEMENT D'EAUX USEES POUR RECHARGER UNE NAPPE SOUTERRAINE: L'INSTALLATION PILOTE DE BERLIN),
F. Sarfert.
Aqua, No 1, p 17-18, 1981. (No English summary).

Descriptors: *Wastewater treatment, *Advanced wastewater treatment, *Groundwater recharge, *Berlin, Germany, Filtration, Biological wastewater treatment, Infiltration, Aeration, *Groundwater management.

Infiltration fields have long been used for groundwater rechange in Berlin. Research is currently underway on optimal methods of treating wastewater prior to artificial recharge in order to produce groundwater of quality equaling that of natural groundwater. Following biological treatment, the wastewater passes through a flocculation tube, a settling basin, a dual media filter, and a pressure aeration tube. The water is infiltrated into the soil via two shafts 200 m deep. The infiltration field comprises a slightly sloping 10 m sand layer over an impermeable marl layer. Water sampling tubes are provided 100 m from the infiltration point. Significant reductions were achieved by the subterranean migration in suspended solids, BOD, DOC, COD, UV extinction, phosphate and E. coli titer. An ozonization stage is under construction. (Carroll-FRC)
W82-04831

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MICROBIAL DEGRADATION OF 14C-DIPHENYLAMINE IN A LABORATORY MODEL SEWAGE SLUDGE SYSTEM,
Food and Drug Administration, Wasnington, DC. Div. of Chemical Technology.
A. M. Gardner, H. G. Alvarez, and Y. Ku.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 1, p 91-96, January, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Activated sludge process, *Aromatic compounds, *Biodegradation, Organic compounds, Amines, Sludge, Model studies, *Wastewater treatment, Industrial effluents, Toxicity.

This report describes the biodegradation of diphenylamine in a laboratory model sewage sludge system. DPA is an aromatic amine, used as a stabilizer in propellants and as an antioxidant in polymers and rubber. The results of degradation experiments using three different 1.5 liter batches of sludge were virtually identical. The average recovery of added radioactivity was 82%. Sludge microorganisms produced some DPA metabolites which were more acutely toxic than the parent material. The metabolites identified suggest that DPA undergoes progressive oxidative metabolism in the sewage treatment process. DPA is probably first oxidized to 4-hydroxy-DPA and an isomeric compound. The oxidized ring is then cleaved, forming water soluble acids which are degraded further to aniline and carbon dioxide. After 6 hr incubation under the experimental conditions, the microbial degradation of DPA was incomplete, with more than 35% of the compound undegraded. Although the identified metabolites are more toxic than DPA, they are not persistent in the sludge mixed liquor after they are formed. (Baker-FRC)
W82-04832

BIODEGRADATION OF 14C-TRIS(2,3-DIBROMOPROPYL) PHOSPHATE IN A LABORATORY ACTIVATED SLUDGE SYSTEM,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
G. H. Alvarez, S. W. Page, and Y. Ku.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 1, p 85-90, January, 1982. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Phosphates, *Activated sludge process, Environmental effects, Biodegradation, *Toxicity, Organic compounds, TRIS, *Industrial wastewater, Path of pollutants, Radioactivity effects.

The fate of tris(2,3-dibromopropyl) phosphate (Tris) in a laboratory activated sludge system was investigated. The distribution of radioactivity from various fractions of biodegradation studies was determined. The total recovery of the added radioactivity was 91%. Thin layer chromatography of petroleum ether extracts showed a single radioactive spot with the same Rf value as authentic Tris. The recovery of undergraded Tris was 55% after 24 hr. The mineralization of Tris by the sludge system was indicated by the C-14 labeled carbon dioxide in the trap, 6% of the added radioactivity. The half-life of Tris was estimated at 19.7 hr by least squares regression analysis. Ethyl ether extracts of both the solids and the aqueous phase contained 21% of the added radioactivity, and the majority of this radioactivity was present in the aqueous phase (18%). TLC of this fraction identified a single spot with Rf 0.64, identical to that of bis(2,3-dibromopropyl) phosphate. The radioactive compound in this fraction was isolated by TLC, methylated, and analyzed by GC/MS, and had a mass spectrum identical to the methyl ester of bis(2,3-dibromopropyl) phosphate. It was concluded that about 50% of the Tris was degraded in 24 hr, with the major metabolite being bis(2,3-dibromopropyl) phosphate. The toxicity and environmental consequences of this metabolite are not known. (Baker-FRC)
W82-04833

CONTROL OF ALUM ADDITION IN WASTEWATER TREATMENT,
Norsk Inst. for Vannforskning, Oslo.
T. Damhaug, J. F. Ferguson, H. Buset, and R. Brusletto.
Water Science and Technology, Vol 13, No 11-12, p 531-537, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrogen ion concentration, *Phosphorus removal, Process control, *Chemical treatment, *Alum, *Wastewater treatment, Alkalinity, Phosphorus, Phosphate, Control systems, Carbon dioxide, Automation, Pilot plants.

Phosphate removal from wastewaters is achieved through the use of alum additions to control eutrophication of surface waters. Results of a national project on 'Instrumentation and Control of Chemical Treatment Plants' are discussed to consider various control strategies for process control which maintain the final pH within an optimum range. Full scale studies showed that in some cases a constant alum feed or time clocked program or flow proportional dosage is sufficient to provide an effective level of control. Numerous deficiencies in design and use were uncovered in a survey of plants using pH feedback control. The main dynamic problem was found to be the rapid deterioration of pH electrode time response. A method which avoids most of the problems of oscillations between the sensor and the chemical dosage with the resulting oscillations in effluent quality is an alkalinity feedforward process. An alkalinity measuring device based on the measurement of CO2 gas by a gas sensing electrode after the conversion of bicarbonate to CO2 was successfully tested in pilot plant studies. (Geiger-FRC)
W82-04837

STRATEGIES FOR THE CONTROL OF ACTIVATED SLUDGE PLANTS TREATING INDUSTRIAL WASTEWATERS,
Aware, Inc., Nashville, TN.
M. L. Duke, W. W. Eckenfelder, and M. E. Templeton.
Water Science and Technology, Vol 13, No 11-12, p 553-559, 1981. 5 Fig.

Descriptors: *Activated sludge, *Performance evaluation, *Biological oxygen demand, *Mathematical models, Process control, Sludge conditioning, Wastewater treatment, Industrial wastewater, Water quality standards, Oxygen uptake, Mathematical studies, Graphical methods, *Activated sludge process.

Mathematical models are presented which provide a rapid assessment of activated sludge plant performance and a guide for operational strategies. Oxygen uptake has been shown to be a useful parameter in the control of the activated sludge process. The effluent quality of a steady-state system may be viewed as a function of sludge age and the degradation properties of the wastewater. The specific oxygen uptake rate (SOUR) is also associated with sludge age and is therefore related to the effluent quality for any wastewater with defined degradation characteristics. For a given activated sludge plant, kinetic coefficients may be calculated from plant operating records and supplemental laboratory investigations. By plugging the coefficients into the mathematical model, graphical relationships of sludge, SOUR, and effluent quality may be obtained. (Geiger-FRC)
W82-04838

NEW FLOCCULATION UNITS WITH HIGH EFFICIENCY,
Bundesgesundheitsamt, Berlin (Germany, F. R.). Inst. fuer Wasser, Boden, und Lufthygiene.
A. Grohmann, M. Reiter, and U. Wiesmann.
Water Science and Technology, Vol 13, No 11-12, p 567-573, 1981. 9 Fig, 5 Ref.

Descriptors: *Flocculation, *Precipitation, *Colloids, *Phosphorous removal, *Design criteria, *Wastewater treatment, Phosphate, Turbidity, Municipal wastes, Separation techniques, Sedimentation, Coagulation, Mixing.

To design flocculation reactors with a more suitable flow pattern, the precipitation and flocculation of phosphate and turbidity caused by the model colloid, skim milk and from effluents of a municipal wastewater treatment plant were investigated. Preliminary studies demonstrated the profitability of performing mixing, precipitation and/or coagulation as well as flocculation in three different units. Flocculation was examined in two new reactors, a cylinder stirrer and a tubular reactor within a turbulent flow region. The mean residence time, concentration of chemicals, input of energy and the dimensions of the reactors were varied. In only 30 seconds, the turbidity and total concentration of phosphate could be reduced to 5% of their original levels. A lower specific energy input was required by the present system than with conventional flocculation units. (Geiger-FRC)
W82-04840

ADVANCED SUPERVISORY CONTROL SYSTEM FOR SLUDGE TREATMENT,
Meidensha Electric Mfg., Co., Tokyo, (Japan).
T. Imamura.
Water Science and Technology, Vol 13, No 11-12, p 575-580, 1981. 3 Fig, 3 Tab.

Descriptors: *Process control, *Digital computers, *Control systems, *Sludge digestion, Wastewater treatment, Automation, Sludge drying, Dewatering, Computers, Data transmission, *Sludge treatment.

A hard-wired logic for a micro-computer-applied distributed control system was designed to control sludge treatment (raw sludge system plus digestion sludge system) in a large-scale wastewater treatment facility. The system is composed mainly of graphic panels, an operation console, industrial instruments, auxiliary relays and other equipment for the supervision of process conditions, the operation of various devices, and automatic controls. The system may be expanded in accordance with the size of the treatment facility, with accompanying problems such as the expansion of installation space and an increase in required man-hours for operators. In the case of expansion or modification of the facility, the system proved less flexible, so that extreme modification or the complete replacement of the supervisory control system was required. (Geiger-FRC)
W82-04841

ULTRASONIC SENSORS FOR MONITORING FLOWS AND SLUDGE SOLIDS CONCENTRATIONS IN WATER AND WASTE-WATER TREATMENT,
Southampton Univ. (England).
W. Balachandran, and R. Briggs.
Water Science and Technology, Vol 13, No 11-12, p 581-588, 1981. 5 Fig, 7 Ref.

Descriptors: *Process control, *Automation, *Sensors, *Suspended solids, *Flow velocity, *Wastewater treatment, Sludge thickening, Dewatering, Sludge drying, Cost analysis, Monitoring, Control systems, Water treatment.

The monitoring of sludge solids concentration, mass and volumetric flows, and other parameters of sludge dewatering is important to water, wastewater, and sludge treatment processes. A technique based on the measurement of auto- and cross-correlation of turbulence-induced electrical noise using ultrasonic sensing equipment has been designed to optimize the monitoring process. Using two pairs of identical sensors, the suspended solids concentration and flow velocities of slurries and sludges have been successfully monitored. Since the system requires an engineered pipe section and various sensor housings for pipes of different diameters, it is a fairly expensive technology. If a reasonable market is established for this technology, significant price reductions should result. (Geiger-FRC)
W82-04842

APPLICATION OF ELECTRO-OSMOSIS TO DEWATERING SLUDGES,
Wroclaw Technical Univ. (Poland). Inst. of Environmental Protection Engineering.
E. S. Kempa, and J. Dobosz.
Water Science and Technology, Vol 13, No 11-12, p 589-592, 1981. 3 Fig.

Descriptors: *Dewatering, *Automation, *Industrial wastes, Sludge thickening, Process control,

Separation techniques, Control systems, Wastewater treatment, Electrochemistry, Sludge conditioning, *Sludge drying, *Electro-osmosis.

An electroosmosis technique was modified to allow automation of sludge dewatering sludge characterized by high specific resistance. The electroosmosis installation was altered by covering the anode with a thin layer of sludge to press it down and ensure humidity near the anode. A vertical flow of liquid ensures process continuity. The optimal potential gradient was 1 V/cm, and the water content of a sludge cake from a crystal-glass works using the technique was 45-50%. Other sludge systems achieved water contents of 60-70% of the total mass. Electroosmosis provided a removal of 80% of the heavy metals via the liquor with a total energy consumption of 80-200 kWh/cu m of sludge. The process has also been successfully applied to sludges from the industrial wastewaters of manufacturers of paints, varnishes, lacquers and synthetic fibers. (Geiger-FRC)
W82-04843

A DYNAMIC MODEL IDENTIFICATION OF THE SLUDGE DEWATERING PROCESS,
Kinki Univ. Osaka (Japan). Dept. of Electrical Engineering.
E. Bamba, S. Yamawaki, M. Yamamura, H. Kitagishi, and T. Yamashita.
Water Science and Technology, Vol 13, No 11-12, p 593-598, 1981. 2 Fig, 3 Tab.

Descriptors: *Mathematical models, *Dewatering, *Mathematical equations, *Process control, Wastewater treatment, Sludge, Mathematical studies, Sludge thickening, Model studies, Control systems.

An identification algorithm called the Revised GMDH (Group Method for Data Handling) algorithm is proposed which gives static and/or dynamic mathematical models. The dynamic mathematical models are used to prepare generalized control equations which are employed as part of a feedforward control that is sensitive to disturbances in the sludge dewatering process. The linearized control equations obtained allow complete control of the dewatering process. The results of this research will be used to design an optimal control system for the dewatering process by taking the appropriate performance index into account. (Geiger-FRC)
W82-04844

AUTOMATIC MONITORING OF COPPER IN WASTE WATER FROM PLATING SHOPS,
Siemens Naamloze Vennootschap, Oostkamp (Belgium).
For primary bibliographic entry see Field 5A.
W82-04845

MANAGEMENT SYSTEM FOR CONTROL OF PROCESS LOSSES AND SPILLS IN THE KRAFT PULPING INDUSTRY,
Tufts Univ., Medford, MA.
G. W. Gove, and J. J. McKeown.
Water Science and Technology, Vol 13, No 11-12, p 545-551, 1981. 3 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Water pollution prevention, *Pulp wastes, *Digital computers, *Simulation analysis, Water pollution control, Industrial wastes, Computer models, Model studies, Analog computers, Mathematical studies, Mathematical models, Kraft mills.

A four-year project was carried out to evaluate analog and direct digital control systems designed to intercept and recover intermittent losses discharged from a kraft pulp mill. A design approach for evaluating spill tank capacity and routing systems through dynamic simulation modeling (DYNAMO) is also presented. Results showed that conductivity and flow could be successfully utilized as inputs to the control system along with values for pumping rate and tank level. Over a two-year trial period, sensors were maintained to yield a 90% reliability, while computer availability was nearly 100%. The intercepted material was returned to recovery rather than to the wastewater treatment facility. The spill control tank was generally kept at less than 20% full. (Geiger-FRC)
W82-04846

AN EXERCISE IN SLUDGE CONSOLIDATION,
W. Campbell, and D. D. McCallum.
Water Services, Vol 85, No 1029, p 551-552, 555, 1981. 2 Tab, 2 Ref.

Descriptors: *Design criteria, *Sludge thickening, *Wastewater facilities, *Separation techniques, Wastewater treatment, Costs, Sludge disposal, Sludge conditioning, Industrial wastes, Cost analysis, Activated sludge, Flocculation, Sludge filters.

The objectives, site investigation and design work carried out prior to the installation of a sludge consolidation plant at the Dextran pharmaceutical manufacturing plant in Holmes Chapel are presented. Sludge generated at the site is derived largely from a Flocor E biofilter system. Main considerations in the design of the sludge handling plant were cost savings (through reduced sludge transport costs), simplicity of operation, ability to handle future increases in sludge production, energy efficiency, odor-free operation, and minimal space requirements. Dewplant (ET) Ltd. was selected to conduct a laboratory investigation of process options and design and to cost out a suitable consolidation scheme based on their results. Laboratory studies showed that gravity separation without expensive flocculants would allow consolidation of raw sludge to 30-50% of its original volume. Duplicate mild steel tanks were used to perform the consolidation on the fill and draw principle. A new thickened sludge holding tank was supplied that provided advantageous disposal rates while meeting space requirements. Duplicate pumps could transfer both consolidated sludge and decanted liquors. Operating results proved satisfactory and have validated design figures. The reduction in volume of transported sludge in 1980 amounted to 575 cu m/month. The final cost savings of the method will depend on the available method of ultimate disposal. (Geiger-FRC)
W82-04848

PACKAGE ANAEROBIC SLUDGE DIGESTION.
Water Services, Vol 85, No 1029, p 556, 559, November, 1981.

Descriptors: *Anaerobic digestion, *Automation, *Wastewater treatment, *Sludge digestion, *Automation, *Farm wastes, Wastewater facilities, Solid wastes, Process control, Mixing, Sludge conditioning, Sludge utilization.

Anaerobic sludge digestion (ASD) reduces pathogens and odors while offering recovery of energy through methane production. ASD is usually feasible only for large wastewater treatment facilities. The retention time for ASD can be reduced to 15 days or less with careful attention to the loading design and heating and mixing systems. The use of steel digesters has cut capital costs and considerably reduced the construction requirements. The Farm Gas ASD plant features automated loading, mixing and heating systems that may be used as unmanned treatment works. Loading is performed by duty and standby positive displacement pumps. Raw sludge is loaded into the top of the digester through an overflow port and is then rapidly dispersed by an unconfined gas mixing system. The sludge is maintained at 35 degrees by means of heated water circulated through an array of tube heat exchangers. The water is heated from a boiler which burns digester gas, and backup heating is provided by electric immersion heaters. The excess gas is used for heating the facility or for payback power generation. An agreement was made in January of 1981 in which Degremont Laing, a subsidiary of Degremont SA of Paris, was licensed to exclusively market the Farm Gas range of ASD systems in the United Kingdom and Ireland. Contracts have already been awarded by Severn Trent Water Authority and the Department of the Environment for Northern Ireland for package ASD plants. (Geiger-FRC)
W82-04850

ISOLATION AND CHARACTERIZATION OF CELLULOLYTIC BACTERIA FROM ACTIVATED SLUDGE,
Louvain Univ. (Belgium). Lab. of Industrial Microbiology and Biochemistry.
K. Ramasamy, M. Meyers, J. Bevers, and H. Verachtert.
Journal of Applied Bacteriology, Vol 51, No 3 p 475-481, December, 1981. 4 Tab, 27 Ref.

Descriptors: *Activated sludge process, *Bacteria, Sewage bacteria, *Culture media, Cellulolytic bacteria, Aerobic bacteria, Cellulomonas, Pseudomonas, Wastewater treatment, Microbiological studies.

An attempt was made to characterize five strains of cellulolytic bacteria isolated from activated sludge using the solid media of Berg et al. and Pochon and Tardieu overlayered with Whatman No. 1 filter paper circles. Colonies appearing in 3-4 days of incubation in the dark at 28 C were transferred to slants of mineral salts medium overlayered with rectangular pieces of filter paper. Inocula from the slants were transferred to tubes of Dubos mineral solution containing a strip of filter paper. After disintegration of the filter paper occurred (3 days), the contents of the test tubes were homogenized, and dilutions were plated onto solid media containing cellulose powder, starch or silica gel overlayered with filter paper. Colonies which appeared pure were transferred to slants of mineral agar covered with filter paper strips. Isolates derived from filter paper overlayered media were mostly cellulolytic and tended to spread, so that incubation time was critical. Incorporation of other substances into the media decreased the percentage of cellulolytic colonies. The five strains studied in detail were rods with a single polar flagellum; strain DK showed a helical structure of the flagellum. The strains were Gram negative (or variable) and non-sporulating; they formed pigments of different colors on starch agar. Strain DK was probably a Cellulomonas and the other strains alcaligenes-like Pseudomonas, though they did not correspond completely to descriptions of known strains. (Carroll-FRC)
W82-04854

TREATMENT OF SECONDARY SEWAGE EFFLUENT WITH A PEAT-SAND FILTER BED,
Forestry Sciences Lab., Grand Rapids, MN.
D. S. Nichols, and D. H. Boelter.
Journal of Environmental Quality, Vol 11, No 1, p 86-92, January-March, 1982. 2 Fig, 6 Tab, 33 Ref.

Descriptors: *Filtration, *Wastewater treatment, *Phosphorus removal, Coliforms, Feces, Nitrogen, Phosphorus, Water quality, Plants, Tertiary wastewater treatment, Advanced wastewater treatment, Peat soils, Separation techniques, Microbial degradation, *Wastewater treatment.

To provide additional treatment of the secondary sewage effluent from a campground on the shore of North Star Lake a peat-sand filter bed was constructed. The lake is within the Chippewa National Forest in north-central Minnesota. The effluent contained an average of 30.9 mg/liter total nitrogen, 8.63 mg/liter total phosphorus, and 122,000 fecal coliforms/100 ml. From late May through early October an average of 6.8 cm/week was applied for an 8 year period. Almost complete removal of fecal coliform bacteria and phosphorus was achieved by the peat-sand filter bed. During the 2nd and 3rd years of operation about 90% of the wastewater nitrogen was removed. By the 5th year this level had declined to about 50% due to the oxidation of the peat and the release of nitrogen. The high iron, aluminum, and ash content of the peat contributed to the highly efficient removal of phosphorus by the filter. During the first 2 or 3 years of wastewater appplication the microbial immobilization in the peat contributed to nitrogen and phosphorus removal. In overall nitrogen and phosphorus removal, rough stalked bluegrass increased each year and accounted for 45% of the phosphorus and virtually all of the nitrogen removal from the wastewater in the fifth year of the study. (Baker-FRC)
W82-04871

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PURIFICATION OF DYE WORKS EFFLUENTS WITH ACTIVE CARBON (REINIGUNG VON FARBEREIABWASSERN MIT AKTIVKOHLE),
Laboratorium fuer Adsorptionstechnik, G.m.b.H., Frankfurt am Main (Germany, F.R.).
J. Wirth.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 173-175, 1981. 5 Fig. English summary.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated carbon, Adsorbents, Water reuse, *Dye industry wastes, Costs, Regeneration, Pilot plants.

Previous attempts to improve the quality of dyeworks effluents by treatment with ozone or flocculants have proven inadequate or expensive. In-plant reuse of treated water, desirable for cost savings and environmental protection, imposes high demands on treatment quality, resulting in residual dye levels below 0.1-0.2 mg/liter. To test the applicability of active carbon on a variety of dyes, adsorption isotherms were prepared, and filtration studies were performed on a laboratory apparatus. The column was able to be operated for 370 hr without dye breakthrough, regardless of the dye type and concentration tested. A small pilot filtration plant using a commercial active carbon was then installed in a dye works. A flow-through photometer was used for continuous measurement of the extinction after treatment. The purified water was almost completely colorless; however, inorganic salts were not removed by the column, nor was the slight turbidity due to textile auxiliaries. About 2 cu m of wastewater could be treated with 1 kg active carbon operated up to full loading. The active carbon was thermally reactivated and reused, allowing for reactivation losses of 5-10%. Only slight differences in coloration were apparent between lots of fabric treated with fresh water and reused water. Treatment costs were estimated at about 2.50 German Marks per cu m, approximately equal to the cost of fresh water. Additional savings would be realized by elimination of discharge fees. Therefore this process seems worthy of further investigation. (Carroll-FRC)
W82-04903

SELECTING ENERGY-EFFICIENT WASTEWATER TREATMENT SYSTEMS,
Resources Conservation Co., Seattle, WA.
T. M. Fosberg, D. Mukhopadhyay, T. M. O'Neail, and R. C. Whalen.
Chemical Engineering Progress, Vol 77, No 10, p 63-67, October, 1981. 5 Fig, 3 Tab.

Descriptors: *Industrial wastewater, *Energy, *Reverse osmosis, *Vapor compression distillation, Zero discharge, *Wastewater treatment, Distillation, Evaporation, Ponds, Waste disposal, Economic aspects, Brine disposal.

Reverse osmosis and vapor compression evaporation are energy-efficient methods of treating wastewaters from industries such as electric power generation, coal gasification/liquefaction, oil shale processing, and metal ore processing. These systems can be combined with evaporation ponds or mechanical drying equipment to achieve zero liquid discharge. The energy requirements (in kWh per 1000 gal wastewater) for these systems are as follows: reverse osmosis, 10; vapor compression evaporation brine concentration, 87; and combined reverse osmosis and vapor compression evaporation, 27. The preferred system for each application must also consider life cycle cost (vapor compression evaporation brine concentration is generally cheaper at lower energy costs of 3-5 cents per kWh) and the choice of pond evaporation vs. mechanical dryers (ponds are preferred for the Southwest and some parts of the West, whereas mechanical dryers are more suitable for the remainder of the country). (Cassar-FRC)
W82-04904

SHALE OIL WASTEWATER TREATMENT BY EVAPORATION,
Battelle Pacific Northwest Labs., Richland, WA.
W. Wakamiya.
Chemical Engineering Progress, Vol 77, No 5, p 54-60, May, 1981. 10 Fig, 3 Tab, 7 Ref.

Descriptors: *Oil shale, *Industrial wastewater, *Evaporation, *Wastewater treatment, *Oil industry, Ammonia, Organic carbon, Sludge disposal, Petroleum industry.

Oil shale retort water, high in organic carbon and ammonia, was effectively treated by evaporation. A 95 liter per day laboratory evaporator removed over 90% of inorganic carbon, conductivity, alkalinity, total solids, and suspended solids. Removal of organic carbon was 70% and of ammonia, 86%. The quality of water produced from the process was high enough for use as irrigation water or boiler feed water. This distillate may also be injected into an aquifer, although the ammonia levels are 9 times higher than in groundwater. The sump concentrate is not suitable for incineration and may be classified as hazardous waste if arsenic and selenium levels exceed regulatory limits. Costs for the evaporation process, including ammonia stripping pretreatment, were estimated at $1.79 to $2.25 per cu m compared with $2.84-$6.51 per cu m for biological and physical treatment methods. (Cassar-FRC)
W82-04905

DESIGNING WASTEWATER TREATMENT SYSTEMS TO SAVE ENERGY,
Edeco, Inc., Tulsa, OK.
B. V. Prather, and W. J. Gossom.
Chemical Engineering Progress, Vol 77, No 10, p 68-77, October, 1981. 12 Fig, 4 Ref.

Descriptors: *Industrial wastewater, *Oil refineries, *Energy, Wastewater treatment, Design criteria, Filtration, Flotation, Gravity flow, Pumping, Operating costs, Oil wastes, Activated sludge process, Separation techniques, Mixing, Aeration, *Sludge disposal, Sludge thickening, Dissolved air flotation.

A procedure for designing petroleum refinery wastewater treatment systems applies rigorous sensitivity analysis to each component of the system to derive the most cost-effective system. The real effects of energy costs and costs of operator attention are balanced against treatment efficiency. Some of the most cost-effective processes are described. Maximum use of gravity flow and minimum differences in elevation for pumping wastewater can reduce pumping energy costs. In the primary treatment step oil/water gravity separators are desirable. Energy saving modifications of the process include part-time operation of skimmers and bottom rakes, proper choice of separator volume, and minimum mixing in equalization basins. Baffles may provide sufficient non-energy-consuming mixing in equalization vessels. In the intermediate step the dissolved air flotation process, which consumes more energy than sedimentation, may be more energy-efficient because it removes more pollutants. Suggestions for optimum design in the dissolved air flotation process include the eductor/emulsifier for producing fine air bubbles and optimum recycle pump design and operation. Secondary treatment by the activated sludge process may be optimized by a high sludge age, vertical upflow tanks, and good mixing. Other treatments for which energy requirements may be determined before choosing a final design are aeration/mixing, clarifiers, and sludge recycle pumps. Advanced treatment options include filters (gravity types are the most energy-efficient) and activated carbon. Land farming requires less energy than other sludge disposal methods. However, a sludge with sufficient oil content (16-18%) may be incinerated without additional fuel. (Cassar-FRC)
W82-04906

ANAEROBIC TREATMENT OF HIGH-STRENGTH WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
A. W. Obayaski, H. D. Stensel, and E. Kominek.
Chemical Engineering Progress, Vol 77, No 4, p 68-73, April, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Anaerobic digestion, *Industrial wastewater, *Wastewater treatment, Aerobic treatment, Methane, Fluidized bed process, Biological treatment, Sludge blanket process, Design criteria, Retention time, *Cost analysis, Nutrient requirements.

Anaerobic system for treatment of high strength industrial wastewaters from food processing, pharmaceutical manufacturing, and distilleries can have annual costs 50% less for pretreatment and 18% less for complete treatment. Many improvements in the anaerobic process have been made within the last 15 years. In the contact process adequate solids retention time is maintained in spite of a reduction in hydraulic retention time. The upflow anaerobic sludge blanket process is the most significant advance in treatment of high-strength wastewaters. A full-scale system has been built to handle sugar beet waste. Other recent developments are the fluidized bed upflow reactor and the Clarigester, a clarifier over a digestion tank. Design of full-scale anaerobic system should begin with an evaluation of wastewater temperature, pH, potential toxic substances, the need for equalization, and nutrient requirements. Advantages of the anaerobic process are low sludge production, low nutrient requirements, no aeration required, 90% conversion of biodegradable organic matter to methane, seasonal operation possible, and high degree of waste stabilization at high loadings. Disadvantages are the lack of practical experience in full-scale operations, the long startup period, poor quality effluent, and sensitivity to variable loads and toxic substances. (Cassar-FRC)
W82-04907

TREATMENT OF COOLING TOWER BLOWDOWN,
Bechtel National, Inc., San Francisco, CA.
A. N. Rogers, M. C. Weekes, S. C. May, and E. H. Houle.
Chemical Engineering Progress, Vol 77, No 7, p 31-38, July, 1981. 3 Fig, 6 Tab, 9 Ref.

Descriptors: *Cooling towers, *Distillation, Reverse osmosis, *Wastewater treatment, Vapor compression distillation, Evaporation, Saline water, Vertical tube foaming evaporation, Scale, Heat transfer, Ponds, Energy, Costs, Operating costs, *Comparison studies.

Three treatments for cooling tower blowdown are compared: reverse osmosis, vapor compression, and vertical tube evaporation. No single process is definitely superior to the others in all aspects. Reverse osmosis requires the least plant investment. Vertical tube evaporation and reverse osmosis are lower than vapor compression in total annual costs. Reverse osmosis and vertical tube evaporation use about one-tenth the electricity that vapor compression does. Reverse osmosis has the largest ponding requirements, minimal long-term operating experience with blowdown, can be constructed in modular units, is very sensitive to upsets in pretreatment, and produces a fair quality product (salinity 475 ppm). Vertical tube foaming evaporation has moderate ponding requirements, no long-term operating experience with blowdown, is not practical to construct in modular units, is not too sensitive to upsets in pretreatment, and produces a high quality product (salinity 10 ppm). Vapor compression has moderate ponding requirements, a successful long-term history of operating with blowdown, is not practical to construct in modular units, is not too sensitive to upsets in pretreatment, and produces a high quality product (salinity 10 ppm). (Cassar-FRC)
W82-04908

BIODEGRADATION OF HAZARDOUS ORGANIC POLLUTANTS,
Illinois Inst. of Tech., Chicago.
For primary bibliographic entry see Field 5B.
W82-04910

SPECIATION OF COPPER AND MANGANESE IN EFFLUENTS FROM THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, and J. N. Lester.
Environmental Pollution, Series A: Vol 27, No 1, p 37-44, January, 1982. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Activated sludge process, *Heavy metals, *Wastewater treatment, Copper Manganese, Effluents, Industrial wastes, Sludge.

The solubility and soluble speciation of heavy metals in effluent samples from an activated sludge simulation were investigated. An attempt was made to relate these phenomena to the capacity of the activated sludge process to remove them. A continuous flow laboratory scale activated sludge simulation system was employed. Ten heavy metals, silver, cadmium, cobalt, chromium, copper, manganese, molybdenum, nickel, lead, and zinc were added continuously to the aerator at nominal influent concentrations in the range of 0.01-0.50 mg/liter. The system was operated at sludge ages of 6, 9, 12, 15, and 18 days, maintained by wasting an appropriate quantity of mixed liquor. Samples of effluent were taken after the system had reached stability at each sludge age. Soluble metal was taken to be that which passed a 0.22 micrometer pore size. The proportions of total copper and manganese in solution were greater than 50% for sludge ages of 6-15 days, but fell to 18% and 7%, respectively at a sludge age of 18 days. This appeared to coincide with an increase in the effluent suspended solids concentration from 25 mg/liter to 50 mg/liter, possibly indicating that the solids had adsorbed significant quantities of both metals. No effect of chemical oxygen demand on metal solubility could be observed, as this parameter did not change appreciably with sludge age. Gel filtration indicated that both copper and manganese were maintained in solution by organic metal-binding fractions, although each metal was associated with different fractions. Copper speciation in the effluent changed with increasing sludge age, whereas forms of manganese were little changed. The data obtained indicate that the association of copper and manganese with different metal binding components may be related to differences in their observed removal efficiencies. (Baker-FRC)
W82-04937

REGIONAL MANAGEMENT OF GROUNDWATER RECHARGE AND POLLUTION IN A RAPIDLY URBANIZING AREA: LONG ISLAND, N.Y.,
Cornell Univ., Ithaca, NY., Dept. of Environmental Engineering.
For primary bibliographic entry see Field 4B.
W82-04956

ACCLIMATION OF SLUDGE FOR EFFICIENT REMOVAL OF NITROGEN FROM FERMENTATION WASTEWATER,
Kogyo Co. Lt., Bofu (Japan).
M. Nagashima, S. Noguchi, and T. Suzuki.
Journal of Fermentation Technology (Osaka), Vol 59, No 1, p 49-53, 1981. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrogen removal, *Wastewater treatment, Nitrates, Nitrites, Nitrification, Nitrous oxide, Fermentation.

Activated sludge acclimated to nitrates and to nitrites differed in their ability to remove nitrogen from fermentation wastewaters. At a given BOD the nitrite sludge reduced nitrite at 2 or 3 times the rate at which nitrate sludge reduced nitrate. Nitrous oxide was formed with the nitrate sludge under high loads of nitrate and BOD but was minimized by rapid recycling and mixing. The nitrate sludge was converted to nitrite sludge by maintaining alkaline pH and high influent loads. (Cassar-FRC)
W82-04990

STUDIES ON BIOLOGICAL NUTRIENTS REMOVAL FROM FERMENTATION WASTEWATER (III). OPERATIONAL CONDITIONS ELIMIATING THE EVOLUTION OF NITROUS OXIDE IN A DENITRIFICATION PROCESS,
Kyowa Hakko Kogyo Co. Ltd., Bofu (Japan).
M. Nagashima, S. Noguchi, and T. Suzuki.
Journal of Fermentation Technology, Vol 59, No 1, p 55-58, 1981. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrous oxide, Fermentation, *Wastewater treatment, Nitrates, Nitrites, Hydrogen ion concentration.

Nitrous oxide formation from two types of activated sludge was studied in laboratory batch operations. Sludge acclimated to nitrate readily reduced nitrate to nitrite. However, nitrite accumulated and nitrous oxide was evolved under these conditions, especially at acidic and alkaline pH. Sludge acclimated to nitrite reduced both nitrite and nitrate to gaseous nitrogen without evolution of nitrous oxide at any pH tested. The results help explain the previous finding that a rapid circulation of liquid between nitrification and denitrification basins eliminated the evolution of nitrous oxide, which is desirable in order to prevent secondary pollution. (Cassar-FRC)
W82-04991

EFFECT OF ROTATION SPEED ON REACTION RATE ON A ROTATING BIOLOGICAL CONTACTOR,
Tokyo Inst. of Tech., Yokohama. Research Lab. of Resources Utilization.
S. Odai, K. Fujie, and H. Kubota.
Journal of Fermentation Technology, Vol 59, No 3, p 227-234, June, 1981. 9 Fig, 2 Tab, 5 Ref.

Descriptors: *Biological treatment, *Rotation speed, *Wastewater treatment, Glucose, Model studies, Rotating biological contactors.

The effect of the rotation speed of the discs of a rotating biological contactor on the biochemical reaction rate in the microbial film was simulated by a mathematical model. This effect was expressed as a rotation factor, which describes the relation between the time-average reaction rate and the rotation speed of the biodisc. The empirical equation, tested in a glucose oxidation experiment, produced results in agreement with the experimental results. The rotation factor is useful in predicting the power economy of the system, which depends on the disc rotation speed. (Cassar-FRC)
W82-04992

CALORIFIC VALUE OF WASTEWATER PLANT SLUDGES,
Marquette Univ., Milwaukee, WI.
For primary bibliographic entry see Field 5E.
W82-04997

KINETIC CONSIDERATIONS ON THE PERFORMANCE OF ACTIVATED SLUDGE REACTORS AND ROTATING BIOLOGICAL CONTACTORS,
Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
A. E. Paolini, and G. Variali.
Water Research, Vol 16, No 2, p 155-160, February, 1982. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Wastewater treatment, Sludge, Activated sludge, Biological oxygen demand, Films, Thin films, *Industrial wastes, Hydraulics, Mathematical studies, Effluents, Performance evaluation, Comparison studies.

A study was designed to compare the performance characteristics of laboratory scale activated sludge and rotating biological contactor (RBC) plants treating the effluent from an urban solid waste processing industry, to verify a simplified design equation for RBC systems and evaluate the possibility of using the kinetic constants of suspended growths for fixed microbial films, and to develop an estimation procedure for the effective surface area of biofilms. A steady-state kinetic model for completely mixed activated sludge reactors with solids recycle and soluble substrate has been used in this study for correlating the experimental results and evaluating the kinetic constants of the suspended growth. Within the range of hydraulic detention time examined, 0.3 to 1.7 days, the activated sludge and RBC units showed very similar biological oxygen demand-5 removal kinetics when the activated sludge concenration and the geometric area of the discs per unit volume of aeration reactor are 2000 mg VSS/liter and 1340 square centimeters/liter, respectively. For disc rotational speeds not limiting microbial growth, a simplified kinetic equation as employed successfully to predict the steady-state performance of RBC systems under conditions of both varying organic loading and varying influent substrate concentration. Also, the kinetic constants of suspended microbial growth may be effectively included in this equation. This equation proves quite useful in evaluating the effective surface area of the biofilm. (Baker-FRC)
W82-05011

SURFACTANT ADSORPTION ON THE WOOL CARBONIZING WASTE (ADSORPTION DE SURFACTANTS SUR LE DECHET LAINIER DE CARBONISAGE),
Ecole Nationale Superieure de Chimie, Toulouse (France), Laboratoire de Chimie Organique et d'Agrochimie.
F. Perineau, J. Molinier, and A. Gaset.
Water Research, Vol 16, No 2, p 189-197, February, 1982. 7 Fig, 5 Tab, 21 Ref. English summary.

Descriptors: *Surfactants, *Wastewater treatment, *Absorption, Wool, Industrial wastes, Acidity, Temperature effects.

Wool carbonizing waste is composed mostly of chemically modified short sized wool fibers and of plant material particles considered as sulfuric lignins. Wool carbonizing waste was considered likely to be a suitable material for the absorption of ionic organic solutes from industrial waste water due to its physical structure as well as to the polar and apolar characteristics of its macromolecules. The absorption isotherms of anionic, cationic, and nonionic surfactants were drawn from various pH and temperature conditions to determine the absorption mechanisms involved as well as the absorption capacity of the carbonizing waste and the optimal absorption conditions. Temperature induced changes in absorption structure enhanced the absorption characteristics. Therefore wool carbonizing waste was proposed for the purification of hot effluents. The processing of anionic surfactant solutions requires acidic media, whereas alkaline media are more suitable for effluents containing cationic surfactants. In both cases ionic bonding is involved. The absorption isotherms have an L-shape, which corroborates the successive involvement of ionic and hydrophobic interactions in the case of ionic surfactants. Langmuir and Freundlich models were used for modeling of water processing units. The processing of industrial effluents in a stirred reactor corroborated the outstanding ability of wool carbonizing waste to absorb cationic surfactants. The tests also showed that the removal of non-ionic surfacta nts is improved when they are mixed with anionic surfactants. (Baker-FRC)
W82-05021

GEOCHEMICAL ANALYSIS OF THE STATE DRINKING WATER STANDARD GOST 2874-73 AND WAYS TO IMPROVE IT,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology.
S. R. Krainov, I. Y. Sokolov, and M. S. Galitsyn.
Water Resources, Vol 8, No 2, p 164-173, March-April, 1981. 2 Fig, 2 Tab, 16 Ref. Translated from Vodnye Resursy, No 2, p 109-119, March-April, 1981.

Descriptors: *Water quality standards, *Drinking water, *Geochemistry, Standards, Groundwater, Water analysis, Mineral water, Public health, Chelation, Metals, Organic compounds, Chemical composition, *USSR.

Creation of optimal state (USSR) drinking water standards and methods of analysis is only possible with close cooperation between hygienists and specialists in geochemistry. As a result of natural processes, groundwater may contain elements in concentrations higher than the maximum allowable concentrations (MAC). Water containing toxic elements or organic compounds derived from wastewater are covered by the standards, but those

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with high mineral contents from natural processes are not. An additional problem is the standardization of certain elements in forms which do not exist in all waters. For example, molybdenum is standardized as Mo(2+) and Mo(6+), but in natural water molybdic anions are predominant. Similarly Se, standardized as SE(4+) and Se(6+), is found in groundwater as HSe03(-), Se03(2-), and HSe(-). The same situation occurs with Be, Pb, Cu, Zn, Fe, and Mn. Many standardized analytical methods do not detect the true concentrations of the elements in question, for example, complexed metals (Fe). The effects of elements vary according to the chemical form. Flourine is most hazardous in sodium bicarbonate waters and much less in BF(-) compounds. The authors state that the drinking water standards should not have MACs lower that the global background concentrations of these elements in natural groundwater. Background levels of Zn, Cu, Mg, Pb, and U are always less than the MAC except in acid or sulfide waters; background levels of Sr, F, Fe, Mn, As, Se, and Be are often near MAC levels. Natural waters high in one or morre of the elements under discussion are identified. (Cassar-FRC)
W82-05025

PROSPECTS OF USING RADIATION WATER TREATMENT METHODS,
P. I. Dolin, and S. A. Brusentseva.
Water Resources, Vol 8, No 2, p 201-205, March-April, 1981. 14 Ref. Translated from Vodnye Resursy, No 2, p 151-155, March-April, 1981.

Descriptors: *Radioactivity, *Disinfection, Reviews, *Wastewater treatment, Industrial wastewater, Detergents, Flotation, Oxidation, Polymers, Animal wastes, Activated carbon, Color removal, *Water treatment, Humic acids.

Radiation disinfection of wastewaters is presently the most promising method of using radiation in water treatment, according to a review of recent developments in this field. It is not clear whether microorganisms are killed by a direct hit of radiation energy or by radiolysis products of water (OH, N, or hydrated electrons). Accelerated electrons (energy 9 MeV, dose 0.2 Mrad) have been used with bubbling air to disinfect wastewater from livestock complexes, producing 100% disinfection of salmonellas, E. coli, and helminth embryos. Radiation plus the action of atmospheric oxygen produces decolorization, removal of tastes and odors, and disinfection of natural waters containing humic substances. Radiation-induced polymerization has been used to treat black liquor from the sulfite papermaking processing with 80-85% removal of lignin. It is also suitable for removing urea and certain dyes. The radiation flotation method in foam has been applied to treatment of wastewater containing nonbiodegradable synthetic detergents (alkyl aryl sulfonates) to reduce foam formation, increase surface tension, and decompose the detergent at the rate of 50 molecule per 100 eV. Organic pollutants extracted into a foam layer may be readily oxidized by this process. Co60 radiation treatment of activated carbon during livestock wastewater treatment prolongs the life of the carbon and produces a highly effluent. (Cassar-FRC)
W82-05026

TRY CHEMICAL TESTS IF INDUSTRIAL WASTES ARE STRONG,
K. A. Bradstreet.
American City and County, Vol 97, No 2, p 26-27, February, 1982. 2 Fig.

Descriptors: *Sewer infiltration, *Flow measurement, *Wastewater treatment, Industrial wastes, Rainfall, Lithium chloride, Wastewater facilities, Secondary wastewater treatment, *Derby, *Connecticut.

Engineers in Connecticut turned to a chemical dilution flow measurement method to determine how greatly infiltration and inflow were adding to a treatment plant's load. The sewage treatment plant in Derby was upgraded in 1973 to include secondary treatment. However, at times when the regulating chambers malfunctioned, excessive flows overloaded the treatment plant, interrupting plant operation. Traditional flow measuring techniques could not be used because large portions of the system were consistently surcharged during high groundwater and storm periods. Some sort of dilution procedure was needed, and lithium chloride was selected as the dilution agent. This compound is ideally suited for this use, as it is rare in most sewer systems, relatively nontoxic and easily measured using an atomic absorption spectrophotometer equipped with a lamp for lithium analysis. It is not affected by chemical reactions which may occur when it is fed into the sewer system. Once samples have been analyzed and flow rates determined, estimates of infiltration and inflow were made. Estimated inflow rates were adjusted based on the ratio of intensity of the rainfall during the gauging compared to expected rainfall intensity during a 10 year storm. (Baker-FRC)
W82-05037

LITERATURE STUDY OF THE BIODEGRADABILITY OF CHEMICALS IN WATER: VOLUMES 1 AND 2,
Franklin Research Center, Philadelphia, PA.
J. Geating.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-100843, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-175/176, October, 1981. 4 p, 1 Fig, 1 Tab, 1 Ref. R806699-01.

Descriptors: *Biodegradation, *Wastewater treatment, *Inhibition, *Mathematical models, *Molecular structure, Model studies, Chemical interference, Bibliographies, Microbial degradation, Microorganisms, *Chemical degradation.

This project was initiated to compile and review post-1974 literature references on aqueous biodegradability of chemicals, to update a previous report. Additionally, literature back to 1913 was searched for inhibitory effects of specific chemicals on wastewater treatment processes. Results are presented as an in-depth hierarchical index and bibliography of 600 items. The index is searchable at three levels: chemical name or chemical class; name of microorganism or type of microbial population affecting or being affected by the chemical; and wastewater treatment process. A structure-activity model was developed to distinguish between biodegradable and nonbiodegradable chemicals. Two parameters were used in the biodegradability model: molecular weight and Wiswesser Line Notation (WLN) based substructural keys. The WLN-based keys are based on major modification of the CROSSBOW program. In a test of the structure-activity model, 270 of 292 degradable compounds, or 92.5% were correctly classified whereas 39 of 57 (68.4%) nondegradable compounds were correctly classified. A total of 25 compounds could not be classified by the model. (Moore-SRC)
W82-05055

DATA BASE FOR INFLUENT HEAVY METALS IN PUBLICLY OWNED TREATMENT WORKS,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
R. A. Minear, R. O. Ball, and R. L. Church.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108168, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-220, October, 1981. 5 p, 2 Fig, 1 Tab, 1 Ref. R805606-01.

Descriptors: *Heavy metals, *Wastewater composition, *Wastewater facilities, *Influent water, Industrial wastewater, Wastewater analysis, Seasonal variation, Waste load, *Wastewater treatment.

The heavy metals loading to publicly owned treatment works (POTW's) is of interest because of: the possible inhibitory effect it has on the biological treatment process; the effluent levels that can be achieved as a function of influent concentration; and the practice of land disposal of waste sludge. Data on influent heavy metals were obtained from 239 wastewater treatment plants. Wastewater treatment plant laboratories were evaluated during the study and generally found to be satisfactory within the framework of the evaluation method. Of the 80,000 individual items of data from the 239 plants, a substantial data base was generated for cadmium, chromium, copper, nickel, lead, and zinc. Extensive data were obtained for silver, arsenic, and mercury. Limited data were obtained for beryllium, cobalt, antimony, and selenium. Aluminum, iron, and manganese data were obtained as well. Overall, the individual plant mean and median metal concentration data tend to fit a log normal distribution. Though no association could be determined between the percent of industrial effluent and metal concentrations in POTW influents, sufficient data were available to determine that cities with less than 4% industrial contribution had significantly lower levels of cadmium, chromium, copper, mercury, nickel, and zinc. Only lead concentrations were not significantly different for the two populations. There were seasonal variations in metal concentration, from 5% to 20% greater in the fall than in the spring. (Moore-SRC)
W82-05056

HEAVY METAL SOURCES AND FLOWS IN A MUNICIPAL SEWAGE SYSTEM: LITERATURE SURVEY AND FIELD INVESTIGATION OF THE KOKOMO, INDIANA, SEWAGE SYSTEM,
Purdue Univ., Lafayetta. IN.
K. J. Yost, R. F. Wukasch, T. G. Adams, and B. Michalczyk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108366, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-224, October 1981. 3 p, 4 Tab. R805361-01.

Descriptors: *Heavy metals, *Cyanide, *Wastewater, *Sludge disposal, *Sampling, Copper, Chromium, Cadmium, Zinc, Nickel, Lead, Pollution load, *Wastewater treatment, Domestic wastes, Land disposal, Pollutant sources, Kokomo, Indiana.

The mass flows of heavy metals (Cu, Cr, Cd, Zn, Ni, Pb) and cyanide in the Kokomo, Indiana, collection system and wastewater treatment plant were analyzed. The primary objectives were to determine the relatve contributions of domestic and nondomestic sources to the total pollutant load in the system, and to assess the levels of discharge control required for the disposal of municipal sludge by landfill or agricultural land spreading. Sampling was conducted at point source locations, in major sewer trunklines and feeder lines, and at the treatment plant. Production and waste treatment data were presented for point sources sampled to characterize metal and cyanide discharges as a function of these parameters. A heavy metals mass balance was attempted for the treatment plant. Metal removal factors were presented for various plant operations. With the exception of lead, metals were found to be largely from nondomestic sources. With the exception of nickel, the Kokomo treatment plant removed 80% to 90% of the influent metals. Required reductions in nondomestic sources of metals to meet EPA landspreading guidelines for sludge were 98% for cadmium, 84% for zinc, and 42% for copper.. A simple statistical approach was presented for the design of a cost-effective sampling program for correlating point source and trunkline pollutant sampling. The purpose was to minimize the amount of sampling required to account for pollutants seen in trukline and treatment plant streams in terms of discharges from specific sources. (Author's abstract)
W82-05061

ENGINEERING AND ECONOMIC ASSESSMENT OF AUTOHEATED THERMOPHILIC AEROBIC DIGESTION WITH AIR AERATION,
Camp, Dresser, and McKee, Inc., Boston, MA.
P. W. Keohan, P. J. Connelly, and A. B. Prince.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102310, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Sum-

mary EPA-600/S2-81-171, October 1981. 4 p, 2 Fig, 1 Tab.

Descriptors: *Aerobic digestion, *Sludge digestion, *Cost analysis, *Aeration, Economic aspects, Sludge drying, Disinfection, Pathogens, Biodegradation, Thermophilic bacteria, Heavy metals.

A major disadvantage of aerobic digestion is that its efficiency is greatly reduced during periods of cold weather. If heat losses are controlled, it becomes possible for the digester system to maintain its operating temperatures within the thermophilic range despite severe winter conditions. Engineering and economic analyses were made of test results obtained in experiments on a modified sludge stabilization process termed autoheated thermophilic digestion (ATAD) with air aeration. Test results were analyzed for system kinetics, heat balance, aerator transfer efficiency, pathogen destruction, dewaterability, and heavy metal interactions. Additionally, economic viability of ATAD was examined using very conservative criteria in application to facilities of 1, 10, and 100 mgd capacity. ATAD with air eration is found to be feasibile on a thickened municipal sludge. The favorable economics at plants of 1 mgd capacity merits serious consideration in planning for design of sludge processing facilities. In general, the characteristics of sludge processed by ATAD to a 40% reduction in volatile solids should be similar to those of sludge processed by ambient aerobic digestion or mesophilic anaerobic digestion. (Moore-SRC)
W82-05071

CARBOHYDRATES AND PROTEINS REMOVALS IN ACTIVATED-SLUDGE PROCEDURE,
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Barteszewski.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 89-96, 1980. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Carbohydrates, *Proteins, *Activated sludge process, Biological treatment, Glucose, Albumin, *Wastewater treatment, Organic loading.

Six synthetic wastewaters, differing in protein concentrations (0 to 198 g albumin per cu m) and carbohydrate concentrations (10 to 647 g glucose per cu m) were subjected to laboratory-scale activated sludge digestion by biomass adapted to high-protein wastewaters. Suitable analytical methods were the pheno method for carbohydrates and the Lowry method for proteins. Removal of the carbohydrates and proteins proceeded in several stages. First, sorption occurred on the surface of flocs, slightly decreasing the concentration of organic matter. Second, protein levels increased temporarily, then gradually decreased. In wastewaters with high carbohydrate levels, carbohydrate concentrations decreased with simultaneous hydrolysis of proteins. When protein hydrolysis was complete, decomposition of both carbohydrate and proteins proceeded simultaneously. A wastewater containing high levels of carbohydrate and no protein degraded only after adaptation; decomposition was linear, not exponential, as in the mixed wastewater. Wastewater containing no protein at the beginning of degradation showed a slight rise in protein levels as the digestion proceeded due to the death of some of the microorganisms. (Cassar-FRC)
W82-05090

TREATING PHENOL RESIN PLANT WASTES,
S. R. Gelman, G. A. Mooney, and H. Craven.
Industrial Wastes, Vol 28, No 1, p 32-35, January-February, 1982. 4 Fig.

Descriptors: *Industrial wastes, *Wastewater treatment, *Phenols, Aerated lagoons, *Resins, Plastics, Biological wastewater treatment.

A two-phase program was instituted at a Georgia phenolic resin plant in efforts to rehabilitate the existing effluent ponds to meet discharge standards and to develop the long-range procedures and facilities needed in order for the plant to meet discharge standards year round under the existing and projected wastewater loadings. Wastewater treatment at the plant consists of two aerated lagoons which may be operated either in series or in parallel. The system provides pretreatment prior to discharge to a municipal sewer. A treatability study was conducted, and the data from that study were used in setting guidelines for treatment system operation. These guidelines have enabled operators to control waste flow into the treatment ponds in a manner that ensures discharge limit compliance. Mass limits were set for biochemical oxygen demand and chemical oxygen demand above which the system would fail. Raw waste is analyzed daily. Allowable flow is then computed from the limits. Prior to the study the operators would pump into the pond the amount of waste generated the previous day. They now pump the maximum volume that will maintain the prescribed phenol or chemical oxygen demand mass limit. Implementation of the results of this study along with increased operator monitoring and attention has considerably improved phenol removal performance and provided highly consistent treatment operations. (Baker-FRC)
W82-05128

BIOLOGICAL NITRIFICATION OF INDUSTRIAL WASTEWATER,
M. Olthof, and J. A. Oleszkiewicz.
Industrial Wastes, Vol 28, No 1, p 29-30, January-February, 1982. 5 Fig.

Descriptors: *Wastewater treatment, *Nitrification, *Activated sludge process, Industrial wastes, Biological wastewater treatment, Nitrogen, Nitrates, Ammonia, Chemical reactions.

Data are presented from two studies on ammonia removal from industrial wastes - one on coke oven effluents and one on a waste acid handling facility. The information was collected to define some of the factors affecting the ammonia removal in a one stage activated sludge system, with particular emphasis on optimization of the biological system with reference to sludge separation, removal rate and temperature effects, and without regard to denitrification facilities that would have to follow. The general trend appears to be a decrease in effluent ammonia concentration with decreased loading. Good sludge separation and control over the final solids carryover is essential to proper management of the bio-systems, since the active nitrifying organisms account for only 3 to 9% of the microorganism biomass of activated sludge, and are the lightest and thus most easily lost from the system. A decrease in chemical oxygen demand to nitrogen ratio was achieved by increasing the nitrogen concentration from 125 to 1,000 mg/l, which yielded substantial increases in the rate of removal in spite of ammonia concentrations in the reactor exceeding 250 mg/l at higher loadings. The temperature exerted a profound effect on all biological systems. The significant effect of temperature on nitrification accounts for the seasonal variation in effluent quality from the existing full scale plants. The successful operation of the biological ammonia nitrogen removal system is dependent on adequate supply of phosphorus and oxygen to oxidize ammonia to NO2 and NO3. (Baker-FRC)
W82-05129

RAILROAD'S SHOPS CORRECT AN OILY WASTES PROBLEM,
Nalco Chemical Co., Oak Brook, IL.
R. Cardile, and R. Fronczak.
Industrial Wastes, Vol 28, No 1, p 20-40, January-February, 1982. 1 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Sludge, *Industrial wastes, Oil, Oil wastes, Wastes, Railroad industry, Oil recovery, *Railroads, Sewers, *Milwaukee, *Railroad yards.

Design and construction changes were made by the Chicago, Milwaukee, St. Paul and Pacific Railroad in an effort to bring the existing treatment facilities at the Milwaukee Shops into compliance with their NPDES permit and local sewer ordinances. In the storm water treatment system, sludge generated from the IAF unit was originally designed to flow into the sludge holding tank and be dewatered on the belt press. The IAF units were designed to perated at a constant flow level through a range of influent flow conditions controlled by a pneumatically operated butterfly valve on the discharge line from the unit. However, this valve was unable to maintain the desired constant level condition. Due to the length and number of weirs in the IAF units, the level in the tank fluctuated so that either too little sludge was removed, resulting in lower quality effluent, or too much sludge was conveyed to the holding tank, causing it to overflow. After various changes had been made, the plant plant operated satisfactorily and allowed the Milwaukee Road shops and Yards to meet requirements. The belt press has proven to be an effective sludge dewatering technique for oily type sludges of railroad treatment facilities. The plant has recovered free oil as a valuable byproduct of the operation of the railroad's shops. Additional methods of sludge treatment are being considered by the firm to further increase oil recovery by releasing oil bound in sludge solids. (Baker-FRC)
W82-05130

SELECTIVE PASSAGE OF HYDROPHILIC NITROGENOUS ORGANIC MATERIALS THROUGH MACRORETICULAR RESINS,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
N. M. Ram, and J. C. Morris.
Environmental Science and Technology, Vol 16, No 3, p 170-174, March, 1982. 3 Tab, 2 Fig, 26 Ref.

Descriptors: *Resins, *Filtration, *Organic compounds, Nitrogen, Humic acids, Water treatment, Adsorption, Carbonates.

Filtration of water samples through a combination of macroreticular resins XAD-8 and Tenax GC was examined as a method of selectively removing hydrophobic carbonaceous materials, such as humic acid, from aqueous solution. Such a method as this might be used as a pretreatment step in the analysis of N-organic hydrophilic substances by first selectively adsorbing potentially interfering hydrophobic materials from solution. The inability of N-organic substances to be absorbed onto the macroreticular resin combination was examined. Prefiltration of the natural water samples selectively removed hydrophobic carbonaceous organic materials without significantly affecting hydrophilic nitrogenous organic substances. Hydrophobic carbonaceous adsorbates competitively decreased adsorption of hydrophilic materials. This phenomenon permits high recoveries of organic nitrogen while simultaneously removing humic material. (Baker-FRC)
W82-05150

SLUDGE MANAGEMENT IN THE ROCKY MOUNTAIN STATE,
Black and Veatch, Denver, CO.
For primary bibliographic entry see Field 5E.
W82-05165

HOW SCREEN MOUNTING AFFECTS MICROSCREENING HYDRAULICS,
Envirex Inc., Waukesha, WI.
J. W. Wittmann.
Water/Engineering and Management, Vol 129, No 2, p 44, 46, 47, February, 1982. 3 Fig, 6 Ref.

Descriptors: *Wastewater treatment, *Screens, Filters, Filtration, *Suspended solids, Design criteria, Hydraulics, *Separation techniques.

Microscreening is a physical straining process used for separation of solids from a liquid suspension by means of the liquid's passage through a porous membrane, defined as the screening or filtering medium. Separation occurs through the retention of solids, either directly by the screen or indirectly by capture of the biomat formed on the screening medium. The microscreen consists of a screening medium attached to the periphery of a rotating horizontal drum. While several studies have been made to establish those criteria which affect the hydraulic design of a microscreen, several significant principles are frequently omitted, foremost among which has been the net effective screening

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area and headloss capability associated with various screening medium mounting concepts. For conventional microscreen applications including the polishing of a secondary effluent, microscreen design has been based on hydraulic loading criteria, defined in terms of gpm/sq ft of nominal submerged surface area. Field research for the development of process technology in the newest microscreening application, algae removal from lagoons, ponds and stabilization basins, led to the establishment of hydraulic loading results in terms of gpm/ft of net effective submerged surface area. The traditional screening media mounting concept employs a fine screening medium backed up by a coarse, typically 10 or 20 mesh screen. The screening grid is an innovative mounting concept consisting of a single screen integrally cast into an 18 by 24 in polypropylene grid with the medium supported on 1 in centers by grid rib framework. Suspended solids removal efficiencies of 70-90% are achievable when operating at a headloss up to 15 in. (Baker-FRC)
W82-05168

A LOW-COST SECONDARY TREATMENT ALTERNATIVE,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water/Engineering and Management, Vol 129, No 2, p 27-28, February, 1982. 4 Fig, 2 Tab.

Descriptors: *Secondary wastewater treatment, *Aerated lagoons, Lagoons, Wastewater treatment, *Wastewater facilities, Activated sludge processes, Sludge, *Economic aspects.

A low-cost alternative to high-maintenance, mechanically complex secondary wastewater treatment systems is provided by dual-power level, multicellular aerated lagoon systems. These systems will discharge effluents low in both suspended solids and biochemical oxygen demand. Such systems consist of a first cell in which sufficient aerator power is applied to maintain all organic solids in suspension. It is followed by a series of cells, each of which is aerated at power levels that permit the settleable fraction of the suspended solids in the effluent from the first cell to settle. The concept of the dual-power level, multicellular system has been followed in the upgrading of existing faculative lagoon systems. One such system is located in a subdivision of Columbia, South Carolina. Preliminary performance data indicate that after the upgrading had been completed, only one BOD5 reading and no total suspended solids readings exceeded 30 mg/l. Most of the values were less than 20 mg/l. A typical activated sludge system where land disposal is practiced provides for conversion of wastewater components to biomass, solids separation, solids stabilization and solids storage. This last step is needed to accommodate the seasonal nature of land disposal. A dual-power level multicellular aerated lagoon system, the solids from which are also disposed of on land, is descriped. This simpler lagoon facility provides for all the steps listed above for the activated sludge system. The advantages held by the dual power level multicellular aerated lagoon systems are primarily economic. The greatest disadvantage is the lack of control over system operation. (Baker-FRC)
W82-05169

VIRGINIANS OPTIMIZE SLUDGE HANDLING,
Lynchburg Regional Wastewater Treatment Plant, VA.
M. H. Thomas.
Water/Engineering and Management, Vol 128, No 12, p 36, December, 1981. 1 Fig.

Descriptors: *Sludge, *Wastewater treatment, *Cost-benefit analysis, *Suspended solids, *Sludge cake, Economic aspects, Rainfall, Land disposal, Effluents, Sludge drying, Sludge thickening, Operating policies, Operating costs, Dewatering, *Lynchburg, Virginia.

The Lynchburg regional wastewater treatment plant in Virginia is described. It serves approximately 70,000 people. It incorporates a thermal conditioning section for the treatment and dewatering of sludge, and it also treats wastes of a paper board mill. By manning and running the thermal conditioning unit on a 24 hour schedule Monday through Friday, several economies have been achieved. Among these are savings on gas, electricity, maintenance, and personnel. In addition, transport costs are saved by eliminating week-end truck services. (Titus-FRC)
W82-05171

REMOVAL OF REFRACTORY ORGANICS FROM WATER BY AERATION. I. METHYL CHLOROFORM,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
T. Lionel, D. J. Wilson, and D. E. Pearson.
Separation Science and Technology, Vol 16, No 8, p 908-935, September, 1981. 22 Fig, 4 Tab, 38 Ref.

Descriptors: *Water treatment, *Aeration, Wastewater treatment, Model studies, Mathematical models, *Methyl chloroform, Chloroform, *Organic compounds, Industrial wastes.

A straightforward mathematical model is presented of an aerator apparatus used for removing volatile organics with a supernatant nonvolatile organic liquid layer. The dependence of the model's output on the physical parameters describing the system being modeled is investigated. Data on the removal of 1,1,1-trichloroethane are reported and used as a test of the mathematical model. The agreement between the observed results and the calculated curves is fairly good. The major discrepancies appear to be associated with uncertainties in the gas chromatographic analysis and with the decrease in temperature during the initial stages of the runs. These data are believed to support the mathematical model. It is noted that the only parameter in the model which is adjustable is the mass transfer rate coefficient. The experimental results are encouraging in terms of the application of the technique for wastewater and drinking water treatment. As an example, it was estimated that 3.39 volumes of air per volume of water removes about 91% of the trichloroethane when the air flow rate is 120 mL/min. At an air flow rate of 60 mL/min, 3.39 volumes of air per volume of water removes about 92% of the trichloroethane. The situation is not so favorable in the case of chloroform, since about 6.0 volumes of air are needed to remove 90% of the chloroform from water with this apparatus. The findings demonstrate the importance of having fairly small bubbles and long columns, which provide large bubble surface-to-volume ratios and long bubble-water contact times, both of which favor increased mass transfer. Solvent sublation is also able to remove nonvolatile materials from water, provided that they are surface-active. (Baker-FRC)
W82-05174

MICROBIAL REMOVAL OF HAZARDOUS ORGANIC COMPOUNDS,
Sohio Research Center, Cleveland, OH.
H. Kobayashi, and B. E. Rittmann.
Environmental Science and Technology, Vol 16, No 3, p 170A-138A, March, 1982. 6 Fig, 3 Tab, 151 Ref.

Descriptors: *Hazardous materials, *Biodegradation, Bacteria, Anaerobic bacteria, *Organic compounds, Degradation, *Wastewater treatment, Fungi, Actinomycetes.

Many microorganisms not previously considered useful for biological waste treatment could be applied to the removal of anthropogenic substances within certain broad limitations. Biological treatment can in numerous cases eliminate hazardous compounds by biotransforming them into innocuous forms, degrading them by mineralization to carbon dioxide and water, or anaerobically decomposing them to carbon dioxide and methane. In contrast to naturally occurring compounds, manmade compounds are relatively refractory to biodegradation. Many environmentally important man-made compounds are halogenated, and halogenation is often implicated as a reason for persistence. Examples of biological reductive dehalogenation are well documented. Specific groups of organisms that may be useful for treating specific types of man-made compounds are briefly discussed, including actinomycetes, fungi, bacteria, phototrophic microorganisms, anaerobic bacteria, and oligotrophic bacteria. The major issues which must be considered in attempts to improve biological treatment by use of selective types of organisms are population selection, development and retention. (Baker-FRC)
W82-05177

INFLUENCE OF TEMPERATURE ON THE ANAEROBIC ACIDIFICATION OF GLUCOSE IN A MIXED CULTURE FORMING PART OF A TWO-STAGE DIGESTION PROCESS,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
R. J. Zoetemeyer, P. Arnoldy, A. Cohen, and C. Boelhouwer.
Water Research, Vol 16, No 3, p 313-321, March, 1982. 11 Fig, 4 Tab, 35 Ref.

Descriptors: *Sludge digestion, *Temperature effects, Activated sludge process, Anaerobic conditions, *Anaerobic digestion, Biodegradation, Digestion, Anaerobic bacteria, Bacteria, Glucose.

The anaerobic acidification of a 1% glucose monohydrate containing medium was studied with respect to maximum dilution rate and product distribution over the temperature range of 20 to 60 degrees C. A Continuous Flow Stirred Tank Reactor inoculated with activated sludge was used for the study, allowing carbon limited growth of microorganisms. A mesophilic and a thermophilic region could be distinguished, with optimum temperatures of 37 degrees C at a dilution rate maximum of 0.51/hour and 52 degrees C with a maximum dilution rate of 0.71/hr. Optimal sludge loadings were 77 and 112 kg chemical oxygen demand/day. The gas phase consisted of carbon dioxide and hydrogen, and yield values ranged between 13.5 and 18.0% as the temperature was varied from 25 to 55 degrees C. Deviations were obtained at lower and higher temperatures. In the liquid phase, mainly acetate, propionate, butyrate, lactate and ethanol were found. Product distribution at the maximum loading rates was fairly constant in the mesophilic range, but was markely variable in the thermophilic range. Product distribution also was highly dependent on sludge loading except at high loadings. Separate acidification should be designed at mesophilic temperature below optimal temperature and at high, almost maximal sludge loadings. (Baker-FRC)
W82-05240

EXPERIENCES WITH PURIFICATION LAKES AND POLISHING LAGOONS,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology, Vol 14, No 1/2, p 189-204, 1982. 16 Fig, 3 Tab, 11 Ref.

Descriptors: *Lakes, *Lagoons, *Tertiary wastewater treatment, Self-purification, Wastewater treatment, Ruhr River, *Germany, Wastewater lagoons, Sediment, Lake sediment, Effluents, Lake Kemnade, Lake Hengstey, Lake Kettwig, Lake Baldeney, Lake Harkort, Recreation, Algal growth, *Ruhr Valley.

Purification lakes and polishing lagoons have been successful in tertiary treatment of wastewater in the Ruhr Valley, Federal Republic of Germany. A series of 5 lakes, built along the river starting in 1929, provide low-cost primary and secondary effluent polishing as well as stormwater treatment. After 40-50 years of operation the lakes have accumulated millions of cu m of sludge, containing high concentrations of phosphate and heavy metals. In 1982 this sediment will be dredged from the river bed and placed in lagoons for dewatering and drying. Polishing lagoons have also been built to further treat effluents from older trickling filter and activated sludge plants. Generally the required 20 mg per liter BOD and 100 mg per liter COD are attained with 1-2 days retention time. An average of 55% of BOD and 31% COD are removed in

this manner. Suggestions for design and operating of lagoons are: 2 days retention time, 1-2 meters depth, ponds in series with gravel beds serving as overflows into the next pond, no lining to allow percolation, and removal of sludge as necessary. The lakes and ponds are desirable for recreation and wildlife observation. (Cassar-FRC)
W82-05241

THE RIVER TAME--A SHORT HISTORY OF WATER POLLUTION AND CONTROL WITHIN AN INDUSTRIAL RIVER BASIN,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5C.
W82-05242

NITROGEN CONTROL FOR THE PARTLY SEWERED BASIN OF YODO RIVER-LAKE BIWA SYSTEM,
Kyoto Univ. (Japan).
S. Iwai.
Water Science and Technology, Vol 14, No 1/2, p 215-225, 1982. 7 Fig, 7 Ref.

Descriptors: *Nitrogen removal, *Eutrophication, *Aeration, Wastewater treatment, *Yodo River, Lake Biwa, *Japan, Phosphorus removal, Model studies, Water pollution sources, Phytoplankton, Nitrification, Denitrification, Faculative denitro-aeration process, Water quality, Water pollution effects.

Water quality in the downstream reaches of the Yodo River and in Lake Biwa, Japan, has deteriorated so that their use as water supplies for 13 million inhabitants is threatened. Sources of pollution in this watershed are nightsoil, lack of sewage treatment, industries, livestock rising, and farming. A simulation process is developed for eutrophication of lake water and applied to Lake Biwa, with good agreement between calculated and observed data. Faculative Denitro-Aeration (FDA) is described for treatment of nightsoil. This consists of simultaneous BOD removal, nitrification, and denitrification with mixed liquor recycle; sedimentation with sludge recycle; nitrification followed by denitrification using methanol as a carbon source; flush aeration; and sedimentation. Recycling distances are very short. The FDA process consumes little power for pumping and can tolerate mixed liquor suspended solids up to 12,000 mg per liter. Removal rates reach 95% BOD5, 90% COD, and 95% total N. This method, with modifications, was used at the Hikone nightsoil plant to produce potable water with no coliforms, 0.4 mg per liter BOD5, 3.7 mg per liter COD, less than 1 mg per liter suspended solids, 3.46 mg per liter total N, 0.41 mg per liter total P, and 180 mg per liter chloride. (Cassar-FRC)
W82-05244

SINGLE SLUDGE NITROGEN REMOVAL FROM INDUSTRIAL WASTEWATER,
AWARE Corp., Nashville, TN.
Y. Argaman.
Water Science and Technology, Vol 14, No 1/2, p 7-20, 1982. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Industrial wastewater, *Nitrogen removal, *Activated sludge process, Wastewater treatment, Nitrification, Denitrification, Biological treatment, Ammonium, Nitrates, Kinetics, Single sludge process.

The single sludge nitrification-denitrification process is described and compared with the two-sludge system. The single sludge process does not require an external carbon source, needs less oxygen and neutralizing chemicals, but may use more pumping energy, depending on the wastewater composition. The design procedure developed in this paper uses zero order kinetics for nitrogenous substrates removal and first order kinetics for carbonaceous organics removal. Trial and error calculations yield a solution. In industrial wastewater applications acid-base equilibria are significant. Inhibition of nitrification and denitrification takes place at both high and low pH levels. Free ammonia is inhibiting at high pH and free nitrous acid at low pH. Nitrification destroys alkalinity, and denitrification forms alkalinity. A bench-scale continuous flow run of an amino acid industrial wastewater containing 6360 mg per liter BOD and 1625 mg per liter total Kjeldahl nitrogen (TKN) produced an effluent with 24 mg per liter BOD and 265 mg per liter TKN. Full-scale operations of a ditch-type system using a combined pharmaceutical-pesticides-herbicides wastewater (influent BOD 800-1100 mg per liter, ammonia-N 32-126 mg per liter) produced a good quality effluent (8-13 mg per liter BOD, 0-18 mg per liter ammonia-N, and 2-7.2 mg per liter nitrate). (Cassar-FRC)
W82-05245

A RELIABLE DISSOLVED OXYGEN PROBE FOR WASTE WATER TREATMENT PLANTS,
For primary bibliographic entry see Field 7B.
W82-05248

HOW THE TYNE WAS SAVED. DUKE OF EDINBURGH OPENS 120 MILLION POUND STERLING SCHEME.
Water and Waste Treatment, Vol 24, No 12, p 22-24, December, 1981. 5 Fig.

Descriptors: *Wastewater treatment facilities, *Design considerations, Wastewater treatment, Construction, *Tyne River, Rivers, England, Hydrogen sulfide, Sludge, Activated sludge process, Primary wastewater treatment, *Odor control.

An innovative manner of dealing with hydrogen sulfide emissions at the Tyneside Sewage Treatment Scheme involves the measured introduction of oxygen. The plan has attracted considerable international interest, as have the remote monitoring arrangements for the sewers and the treatment works of this scheme. Twenty-five miles of interceptor sewers have been built, out of the eventual total of 45 miles, and now most of the main sewers on both banks of the east of the Tyne Bridge section are completed. The total length of sewers in the completed scheme will be about 75 km, varying in internal diameter between 0.45 and 3 meters. The system is designed so that most of the sewage flows by gravity, but in some places pumping stations have had to be built to lift the sewage from low lying areas. Primary treatment is expected to be sufficient to maintain the Tyne estuary in a healthy state, but if the sewage load should increase or a higher standard of river water quality is needed in the future, enough land is available on the site for further treatment. (Baker-FRC)
W82-05249

CONTAINMENT AND TREATMENT OF THE LOVE CANAL LANDFILL LEACHATE,
Niagara Falls Wastewater Treatment Plant, New York.
W. J. McDougall, R. A. Fusco, and R. P. O'Brien.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2914-2924, December, 1980. 7 Fig, 7 Tab, 4 Ref.

Descriptors: *Landfills, *Leachates, *Organic compounds, *Activated carbon, Priority pollutants, Wastewater treatment, Adsorption, *Love Canal, *New York, Path of pollutants, Chemical wastes, Chlorinated hydrocarbons.

The leachate containment and collection system built at the Love Canal chemical landfill site near Niagara Falls, New York are described. At this site, rainwater entered the top layer of permeable soil, carrying contaminants laterally. In the southern sector of the dump area an impervious clay cap was constructed to minimize surface water entrance. A perimeter drain tile collection system of 8 inch perforated pipe, 10-15 ft deep, carried the leachate to pumping stations, where the contaminated water was fed to an activated carbon treatment system. The temporary 2-stage adsorption system installed held a full truckload of 20,000 pounds of granular carbon in each vessel and processed 175 gal per min of wastewater. Spent carbon was transferred to an empty truck for reactivation at another site, and the empty vessel was refilled with a fresh truckload of carbon. All carbon transfers were handled in a closed system to prevent workers' exposure to the spent carbon. Assessment of the treatment showed a removal rate of nearly 100% for some of the 80 organic compounds identified in the leachate. Only 67% of the methylene chloride was removed. A permanent carbon system was started up in December 1979. This has continued to operate satisfactorily according to specifications. (Cassar-FRC)
W82-05250

PERFORMANCE OF A LARGE ADVANCED WASTE TREATMENT PLANT,
Alvord, Burdick and Howson, Chicago, IL.
D. E. Eckmann, and H. S. Zimmerman.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2717-2725, November, 1980. 7 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Evaluation, Advanced wastewater treatment, *Wastewater facilities, Reservoirs, Eutrophication, Water pollution sources, *Water pollution prevention, Roanoke, *Virginia, *Smith Mountain Lake.

A dam was built on the Roanoke River to create Smith Mountain Lake in southwest Virginia in the 1960s. This lake is one of the finest recreational reservoirs in southwest Virginia. The state determined that the Roanoke Sewage Treatment Plant, which is located upstream from the dam, had to be upgraded to control eutrophication of the lake. A 132 M1/d advanced wastewater treatment plant was built for about $28 million, and has been in operation for more than one year. It has at times treated flows of over 227 M1/d (60 mgd) and on an annual average has produced the following quality effluent: biochemical oxygen demand 1.8 mg/1, suspended solids 0.8 mg/1, phosphorus 0.1 mg/1, total Kjeldahl nitrogen 0.2 mg/1, and fecal coliforms 2.8/100 ml. The plant consists of the activated sludge process followed by nitrification, flocculation, coagulation, filtration, and disinfection facilities. The quality of the effluent under average and maximum conditions, the effect of each process upon the overall treatment, amount of sludge generated, chemicals used, and other major parameters of each process are presented with special emphasis on filtration as well as construction and operating costs. (Baker-FRC)
W82-05251

MICROBIAL ECOSYSTEMS RESPONSIBLE FOR ANAEROBIC DIGESTION AND COMPOSTING,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5E.
W82-05252

SHOCK LOAD OF CHROMIUM (VI),
Mankato State Univ., MN.
R. C. Henney, M. C. Fralish, and W. V. Lacina.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2755-2760, November, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Chromium, *Activated sludge process, Sludge, *Wastewater treatment, Industrial wastewater, Biological wastewater treatment, Microorganisms, Bacteria, Chemical spills, Electroplating.

A spill of about 227 kg of chromium(VI) from a slowly overflowing electroplating tank into the collection system of the Mankato, Minnesota 38,000 cubic meter/day (10 mgd) activated sludge plant occurring on October 23-24, 1977, precipitated this study. Automatic samplers at the wastewater treatment plant sampled the influent and effluent before, during, and after the spill along with additional grab samples from various plant units. The greatest effect of the chromium(VI) on the activated sludge process was seen in the aeration tanks, where the activity of the organisms was severely, but only temporarily, depressed. The greater part of the shock load of chromium(VI) passed through the plant with the wastewater. Chromium(VI) was removed by wastewater treatment processes only to the extent that it was reduced to chromium(III), a process

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that depended on the concentration of dichromate as well as the acidity and the concentration of reducing substances. Chromium(III), being insoluble at the normal acidity range of the wastewater, remained largely in the plant adsorbed onto the sludge particles, but in moderate amounts was apparently not harmful either to the processes in the aeration tank or to those in the digesters. Since the chromium(III) ended up in the finished sludge, the disposal of the sludge must be monitored. (Baker-FRC)
W82-05253

NITRIFICATION IN THE SEQUENCING BATCH BIOLOGICAL REACTOR,
Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, and R. L. Irvine.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2747-2754, November, 1980. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Nitrification, *Biological wastewater treatment, *Wastewater treatment, *Sludge, Bacteria, Nitrates, Oxidation, Acidity.

Studies were conducted to demonstrate the potential of the sequencing batch reactor to maintain combined organic carbon oxidation and nitrification. Using a synthetic, high-strength waste input, a bench-scale sequencing batch reactor (SBR) consistently discharged a good quality effluent, with 98+% oxidation of both the organic carbon and nitrogen components. A high quality discharge was maintained over a 2 month period. Sludge settleability was extremely good, producing a clear effluent with suspended solids averaging 6 mg/l. Sludge Volume Index measurements remained steady at 85 to 95. There was no indication of the pin floc and/or transient settling abnormalities that have been known to plague the low loading FCSTR-nitrification systems. Sequential exposure to periods of reduced oxygen tension had no apparent effect on the activity of the nitrifying bacteria. A depression in alkalinity did occur during the nitrification period, although the extent of the reduction was markedly less than the stoichiometric rate based on proton release through ammonium ion oxidation. Overall, the sequencing batch reactor unequivocally demonstrated a capacity for combined oxidation of organic carbon and nitrogen. The SBR design also provided a unique opportunity to follow the metabolism of the substrate species during the React phase. (Baker-FRC)
W82-05254

A SURVEY OF PHOSPHORUS REMOVAL IN LOWER GREAT LAKES MUNICIPAL TREATMENT PLANTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
M. S. Switzenbaum, J. V. DePinto, T. C. Young, and J. K. Edzwald.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2628-2633, November, 1980. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Effluent limitations, *Phosphorus removal, *Great Lakes, *Municipal wastewater, *Chemical coagulation, Phosphorus, Water quality standards, Lakes, Wastewater treatment, Surveys, Water quality control, Chemical treatment, Lake Erie basin, Lake Ontario basin.

A questionnaire was sent to 229 municipal wastewater treatment plants in the Lake Erie and Lake Ontario basins with effluent flows greater than 3,785 cu m/day. Results of the survey showed that the approach most commonly used to comply with the 1978 Great Lakes Water Quality Agreement for phosphorus was the addition of iron or aluminum salts to the wastewater during secondary treatment. Currently 52% of the treatment facilities surveyed have effluent total P levels of less than or equal to 1.0 mg/l. Total P loadings to the two lakes were determined. It was estimated that a 0.5-mg/l P effluent standard alone would not be sufficient to achieve the International Joint Commission target loads of 11,000 and 7,000 metric tons/year for Lake Erie and Lake Ontario, respectively. (Geiger-FRC)
W82-05256

RELATIVE HEALTH RISKS OF ACTIVATED SLUDGE TREATMENT AND SLOW-RATE LAND TREATMENT,
Metcalf and Eddy, Inc., Palo Alto, CA.
A. Uiga, and R. W. Crites.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2865-2874, December, 1980. 12 Tab, 24 Ref.

Descriptors: *Risks, *Land application, *Activated sludge process, Public health, Wastewater treatment, Wastewater irrigation, *Wastewater disposal, Lagoons, Aerosols, Viruses, Bacteria, Pathogens, Metals, Organic compounds, Sludge treatment, Sludge disposal.

The potential health effects of two wastewater treatment systems--activated sludge with effluent discharge to surface water and slow-rate land application-- are compared. Evaluation considers contact intensity (physical, aerosol inhalation, accidental ingestion, and potable ingestion) and contact duration. Both systems, if properly maintained, minimize health risks. Slow-rate land treatment offers greater protection against parasites and viruses, trace metals, nitrates, and trace organics and is less susceptible to process upsets. Workers at treatment facilities may be exposed to infectious agents via aerosol inhalation and incidental contact, but the health risks are no greater than for the general public. Wastewater irrigation of non-food crops is safer than irrigation of food crops. Health hazards from trace metals and trace organics are difficult to evaluate. Some of the differences in health risks are a result of the high concentration of the sludge versus the more dilute and more widely dispersed wastewater applied to land. (Cassar-FRC)
W82-05258

ION-PRECIPITATE FLOTATION OF IRON-CYANIDE COMPLEXES,
International Nickel Inc., Sterling Forest, NY.
R. O. Bucsh, D. J. Spottiswood, and G. W. Lower.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2925-2930, December, 1980. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Cyanide, *Metal-finishing wastes, *Flotation, Surfactants, *Wastewater treatment, Iron compounds, Ferrocyanide, Ferricyanide, *Separation techniques.

Removal of cyanide, ferrocyanide, and ferricyanide ions from wastewaters was accomplished by an ion-precipitate flotation process. Tricaprylmethyl ammonium chloride, a surfactant, combined with cyanide ions to form a waxy material. This substance rose to the surface during air flotation. Average recoveries of the three ions were: cyanide, 28%; ferrocyanide, 73%; and ferricyanide, 71%. Process variables were studied, using ferricyanide for most experiments. Recovery of ferricyanide increased with surfactant dosage to 1.25 times the stochiometric amount of surfactant. Chloride ion decreased the critical micelle concentration; up to 1.5 stochiometric multiples of surfactant, more ferricyanide was removed without chloride than in the presence of chloride. Removal decreased with feed flow rate increases up to about 500 ml per min, and became constant at higher flow rates. An air flow rate above 3 liters per min caused a sharp drop in removal of ferricyanide. Ferricyanide at concentrations < 15 ppm was poorly removed because wax moelcules were too few to agglomerate and float. The concentration-recovery curve leveled off at about 30 ppm. Although pH slightly decreased removal at pH 7-10, recovery was acceptable over the range 4-10 pH. (Cassar-FRC)
W82-05259

CONTROL OF SLUDGE BULKING IN THE BREWING INDUSTRY,
Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
H. G. Schwartz, Jr., T. Popowchak, and K. Becker.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2977-2993, December, 1980. 11 Fig, 6 Tab, 16 Ref.

Descriptors: *Fermentation, *Sludge bulking, *Process control, Wastewater treatment, Industrial wastewater, *Activated sludge process, Carbohydrates, Shock loads, Organic loading, Dissolved oxygen, Oxygen, Nutrients, Chlorination, Hydrogen peroxide, Oxidation, *Brewing industry.

The Miller Brewing Company wastewater treatment plant at Fulton, New York, suffered two extended periods of filamentous sludge bulking and solids loss during the first two years of operation. These incidents (September 1976 to February 1977 and November 1977 to April 1978) presented opportunities for evaluating control methods. The single most cirtical factor in maintaining a healthy mixed microbial population was adequate dissolved oxygen, no less than 2 mg per liter, throughout the aeration basin. In addition, nitrogen, phosphorus, and possibly iron were essential nutrients. The activated sludge system, operating with variable strength, high carbohydrate wastes, required careful monitoring and control to equalize waste loads. On one occasion a shock load of caustic cleaning solution and disinfectants destroyed the microbial population. A plant information program was prepared to educate plant personnel about the harmful effects of shock loads and toxic substances. When settleability dropped and sludge blankets rose, immediate treatment with 10-20 mg per liter cationic polymers allowed restabilization. Chlorination and hydrogen peroxide additions were ineffective in reducing sludge bulking at this plant. Since conditions that lead to sludge bulking take several weeks to develop, corrective measures ususally requie several weeks to be effective. Since the latest recovery period, effluents from the treatment plant have met discharge permit standards. (Cassar-FRC)
W82-05260

ULTRA-HIGH-RATE FILTRATION OF RAW AND COMBINED SEWER OVERFLOWS,
Environmental Protection Agency, New York.
H. Innerfeld, and D. Ruggiero.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2931-2945, December, 1980. 2 Fig, 12 Tab, 1 Ref.

Descriptors: *Combined sewer overflows, *Filtration, *Wastewater treatment, High rate filtration, Suspended solids, Biological oxygen demand, Chemical oxygen demand, Alum, Polyelectrolytes, Settleable solids, Backwash, *Newton Creek Water Pollution Control Plant, *New York City.

Combined sewer overflows (CSO) and raw dry weather wastewater flows (RDWWW) were treated by ultrahigh-rate filtration at a pilot plant located in New York City's Newtown Creek Water Pollution Control Plant. The 760 mm diameter filter column contained 1.5 m of No 3 anthracite above 760 mm of No 612 sand on a 460 mm gravel base. CSO treatment at 11 liters per sq m per sec removed suspended solids at an average of 62% across the filter and 66% across the system. BOD removals were 32% and COD removals 40%. Polymer and alum additions improved removals to 38% for BOD and 50% for COD. Treatment of RDWWW at 5.4 liters per sq m per sec produced suspended solids removals of 67% across the filter and 70% across the system, BOD removals of 33%, and COD removals of 32% across the filter. Addition of polymers improved performance to 39% for BOD and 34% for COD at flow of 8.1 liters per sq m per sec. Use of polymers plus alum did not improve filtration further. Since % removals of suspended solids are dependent on the strength of influent flows, the filtration system should be rated on the basis of total solids captured per unit filter area. This should be at least 15.1 kg per sq m for RDWWW and 22.0 kg per sq m for CSO. Settleable solids were removed to an extent of 95% or greater, but dissolved materials were not removed. (Cassar-FRC)
W82-05266

MATHEMATICAL MODEL OF SEQUENTIAL LOADING IN FIXED-BED ADSORBERS,
Michigan Technological Univ., Houghton.
J. C. Crittenden, B. W. C. Wong, W. E. Thacker, and R. L. Hinrichs.

Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2780-2795, November, 1980. 5 Fig, 1 Tab, 43 Ref.

Descriptors: *Model studies, *Adsorption, *Wastewater treatment, Mathematical models, Water treatment, Water quality, Organic compounds, Adsorbents.

This work is part of a continuing effort to develop a model that accurately predicts the organic removal efficiency of fixed-bed adsorption systems. The model will be useful to the design engineer in the designing of adsorbent systems which minimize the possibility of chromatographic desorption of weakly adsorbed toxics, in the selection of adsorber design likely to yield the best quality effluent at the least cost, and in the selection of adsorbents based on relatively simple and quick batch tests. The focus of the study was on the development of a model able to predict displacement or chromatographic effects. The model described predicts the concentration history profiles of binary mixtures with time-variant influent feed conditions. Mass balance relationships within the column in the axial direction and within the adsorbent particles in the radial direction that incorporate Fick's Law for the intraparticle surface diffusion flux and film transfer for the liquid-phase diffusion flux were the conceptual basis of the model. Orthogonal collocation was used to solve the model equations. Model predictions were compared to column data for these two time-variant influent conditions: the non-key component was fed until the adsorber was exhausted and then both adsorbates were fed until the adsorber was exhausted with respect to the key component; and the reverse loading order. These comparisons represented a verification of the model for sequential influent loadings and for single solute adsorption because good agreement between model predictions and data was found and because parameters used in the model were obtained from independent tests. (Baker-FRC)
W82-05269

PHOSPHORUS AND NITROGEN REMOVAL AT CADILLAC, MICHIGAN,
Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
A. K. Singhal.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2761-2770, November, 1980. 7 Fig, 8 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Water pollution control, Phosphorus, *Phosphorus removal, *Nitrogen removal, Suspended solids, Alkalinity, Acidity, Advanced wastewater treatment, *Cadillac, Michigan.

The advanced wastewater treatment at the Cadillac, Michigan treatment facility all but eliminates pollution to the receiving stream, the Clam River, thus allowing recreational use of the waters without endangering public health. The plant is able to meet stringent state and federal treatment requirements with overall removals of greater than 97% biochemical oxygen demand (BOD), 96% suspended solids (SS), 92.5% ammonia nitrogen, and 80% phosphorus. Experience at the plant indicates that an aeration system can be effectively used for phosphorus removal provided the air quantity after addition of ferric chloride or alum is properly adjusted to provide velocity gradients of around 50/sec. Equations are presented which can be used to estimate the air requirements for any given plant. The design of an aeration system piping should make provisions for monitoring the air input into the portion of the system being used for phosphorus removal by using air-flow metering devices. Attached biological growth systems using rotating biological contactors (RBC) can be successfully used for ammonia nitrogen removal from secondary effluent. Consistent BOD and SS removal are obtained by using rapid sand filters at the end of the RBC units. There does not appear to be a need for a clarifier between the RBC and tertiary sand filters in a system treating secondary effluent. Design of a nitrification system should take into account the impact of various parameters such as alkalinity of the influent wastewater and impact of ammonia nitrogen loading and provide for potential accumulation of heavy metals in the attached growth systems. (Baker-FRC)
W82-05270

COMPREHENSIVE ANALYSIS OF NITRIFICATION OF CHEMICAL PROCESSING WASTEWATERS,
Engineering-Science Inc., Austin, TX.
D. L. Ford, R. L. Churchwell, and J. W. Kachtick.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2726-2746, November, 1980. 16 Fig, 4 Tab, 33 Ref.

Descriptors: *Industrial wastewater, *Nitrification, Chemical analysis, Ammonia, *Wastewater treatment, *Biological processes, Microorganisms, *Huston, Texas.

To determine the feasibility of enchancing biological nitrification of the wastewater discharged from the Tenneco Chemicals plant in Houston, Texas, a series of comprehensive bench-scale treatability studies was undertaken. Throughout the program an extensive effort was made to isolate and quantify Nitrobacher and Nitrosomonas. The fraction of viable bacteria that these autotrophs represented in the mixed liquor was then correlated with specific system variables such as ammonia-nitrogen loading, resultant-fee ammonia and free nitrous acid concentrations and specific ammonia removal. The study was divided into two parts. In the first part a control reactor with an aeration and side-stream reaeration system evaluation was used. The second study concerned a control reactor with a two-stage aeration system evaluation. Biological nitrification did not change organic removal capacity of the biological reactors. Data showed that free ammonia concentrations of 30 mg/l or higher may be inhibitory to Nitrosomonas. Free nitrous acid concentrations from 0.28 to 1.0 mg/l tended to inhibit Nitrobacher, resulting in nitrite accumulation. (Baker-FRC)
W82-05271

USE OF BENCH-SCALE DIGESTERS TO EVALUATE FULL-SCALE DIGESTER PERFORMANCE,
C. M. Engineering Associates, Vista, CA.
J. S. Murk, J. L. Frieling, L. D. Tortorici, and C. C. Dietrich.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2709-2716, November, 1980. 8 Fig, 2 Tab.

Descriptors: *Digestion, *Evaluation, *Wastewater treatment, Wastewater facilities, *Anaerobic digestion, Laboratory studies, Performance evaluation, Monitoring, *Encina Water Pollution Control Facility, California.

A large municipal wastewater treatment plant in Southern California was used to demonstrate the reliability and accuracy of laboratory scale pilot digesters to duplicate and predict the performance of full scale anaerobic digester. Three 28 liter bench scale digesters were fabricated and operated at the Encina Water Pollution Control Facility, a 52,040 cubic meter/day regional wastewater treatment plant in North San Diego County, to help overcome a chronic operational problem with foaming digesters. These bench scale anaerobic digestion studies have afforded an economical, reliable, and simple approach to determining the causes for digester foaming. By this inexpensive technique, design and operational changes have been implemented, providing improved digester performance and unhampered operation. Properly designed laboratory scale digesters can greatly assist in controlling and maintaining anaerobic digester performance and determining at little cost the reasons for process inefficiencies. (Baker-FRC)
W82-05272

DEVELOPMENT OF EVALUATION OF ION-EXCHANGE RESINS FOR REMOVAL OF SPECIFIC METALS IN WATER TREATMENT,
West Virginia Univ. Morgantown. Water Research Inst.

For primary bibliographic entry see Field 5F.
W82-05282

LOW PRESSURE MEMBRANE SEPARATION PROCESS TO REMOVE HEAVY METAL COMPLEXES,
Kentucky Water Resources Research Inst., Lexington.
D. Bhattacharyya, and C-S. Cheng.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224619, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 129, September 1981. 142 p, 42 Fig, 16 Tab, 35 Ref. OWRT B-059-KY(1), 14-34-0001-9073.

Descriptors: *Heavy metals, *Membrane processes, *Wastewater treatment, Chelation, *Chelating agents, *Ultrafiltration, Charged membrane ultrafiltration, Donnan Exlusion, Rejection model, Complex species, EDTA, Oxalates, Cyanide, Zinc, Copper, Cadmium, *Separation techniques.

The rejection behavior of heavy metals was established in the presence of complexing agents, utilizing negatively charged ultrafiltration membranes. An extensive experimental investigation was conducted with Zn, Cd, and Cu, in the presence of cyanide, ethylenediamine tetraacetic acid, and oxalates, under insignificant concentration polarization condition. The rejection dependence of the heavy metals was found to be a function of feed metal concentration, metal types, complexing agent to metal feed molar ratio, pH and ionic strength. The dependence of rejection behavior of heavy metals and complexing agents on pH concentration is explained in terms of metal complex species distribution and Donnan Exclusion model. For EDTA and oxalate systems, the rejections of metal are independent of initial metal concentration; whereas for the cyanide system the rejections of both metal and cyanide decrease with concentration. At transmembrane pressure of 5.6 x 10 to the fifth power N/sq m, metal rejections range between 77% and 96%. For all cases, the rejection of metal is highly dependent on the size and charge of the complex metal species.
W82-05284

FILTRATION PERFORMANCE IN WATER AND WASTEWATER TREATMENT: THEORY AND MEASUREMENT,
Wright-Pierce Architects/Engineers, Portsmouth, NH.
J. E. Tobiason, and C. R. O'Melia.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224627, Price codes: A07 in paper copy, A01 microfiche. Report No 172, March 1982, 110 p, 28 Fig, 5 Tab, 60 Ref. 2 Append. OWRT A-104-NC(2), 14-34-0001-9035.

Descriptors: Sand filters, Soil filters, Mathematical models, *Filter performance, *Flocculation, *Filtration, Filter media, Filter rate, *Wastewater treatment, *Particle size, Granular filter, Filter theory, Filter ripening.

An earlier model for filter ripening, designed to predict changes in effluent quality and head loss with time as filtration proceeds, was extended and applied. Reasonable agreement was found between observed and predicted filtrate quality. Head loss predictions are quantitatively similar to observations but are generally lower. Suspensions containing small particles produce more head loss than suspensions of larger particles when the comparison is based on equivalent masses of solids removed by the filters. Particles smaller than a few microns in size are particularly troublesome in this regard. This indicates that flocculation prior to filtration is important when direct filtration is considered, particularly when submicron sized particles are to be treated. Additional important effects have been noted for the concentration of solids applied to a filter and, as noted by others, for the chemistry of the pretreatment processes. High concentrations of suspended solids are observed to produce more head loss than lower concentrations.
W82-05285

LIBRARY U. of I., URBANA-CHAMPAIGN

RETENTION OF URBAN DERIVED PHOSPHORUS BY AN ALLUVIAL SWAMP OF THE COASTAL PLAIN OF GEORGIA,
Georgia Southwestern Coll., Americus. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-05286

CHARACTERIZATION, RENOVATION, AND UTILIZATION OF WATER FROM SLURRY TRANSPORT SYSTEMS,
Missouri Water Resources Research Center, Columbia.
S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224668, Price codes: A02 in paper copy, A01 in microfiche. Report, February 1982. 22 p, 10 Fig. OWRT B-145-MO(2), 14-34-0001-0228.

Descriptors: *Slurries, *Chromium, *Coal, Water exchange, *Sorption, Heavy metals, Baseline studies, Water use, Water conveyance, Water carrying capacity, Water transport, Energy sources, Resources management, Water management, Industrial water, Industrial development, Chemical properties, Corrosion control, *Wastewater renovation.

An understanding of water-solid interactions under slurry conditions is needed in order to characterize, renovate, and utilize water from slurry transport systems. To address this need, study emphasis was placed on two major considerations: water interchange between the suspending medium and the coal and coal-derived solids; and the interaction of coal and coal-derived solids with chromium (VI), or chromate, an anticorrosive agent that may be used in coal slurries. Materials used in these investigations were prepared in laboratory-scale operations from ground and sieved Wyoming subbituminous coal. Water interchange was studied in experiments using radiolabelled tritiated water. Sorptin of chromium (VI) by solids was studied in slurries containing 10 g of damp solid and 10 ml of chromate solution as a function of pH. The study results indicated that coal and coal-derived solids have a strong affinity for certain solutes in water, such as chromate, with (generally) a rapid instantaneous sorption of a fraction of the solute occurring. Water interchange study indicated that part of this rapid sorption may be due to exchange of exchangeable water in initially moist solids. The methodology employed here and the concept of exchangeable water and its dilution effect should be useful in future studies of coal-water interactions. (Zielinski-MAXIMA)
W82-05289

STUDIES OF NITRIFICATION IN A COKE-WASTE ACTIVATED SLUDGE PROCESS,
Alabama Univ., Birmingham. Dept. of Biology.
D. D. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224700, Price codes: A04 in paper copy, A01 in microfiche. Report, September 1981. 27 p, 8 Fig, 10 Tab, 22 Ref. OWRT A-075-ALA(2), 14-34-0001-0101.

Descriptors: *Nitrification, *Bacteria, *Activated sludge process, *Coal, *Industrial wastewater, Activated sludge, Fluorescence, Microbial degradation, Industrial wastes, Refinery wastes, Ammonia, Biodegradation, Sludge digestion, Bioassay, Biological wastewater treatment, Baseline studies.

Studies were carried out to assess the effects of environmental conditions on the activity of nitrifying bacteria in a coke-waste activated sludge process using samples of mixed liquor obtained from bench-scale reactors handling wastewater from a commercial Alabama coke plant. Using a fluorescent-antibody technique which could provide reliable estimates of the number of nitrifiers within a few hours, it was found that coke-plant mixed liquor contains about four orders of magnitude more Nitrosomonas (N) cells than shown by MPN (most probable number) estimates. It was also determined that N comprises about 2% of the total cells in the liquor at 25 day solids retention tines (SRT) or greater, and about 1% at 4.2 days SRT. Correlations between effluent ammonia and N population dynamics indicated that the ammonia removal rate in the liquor is affected by both the number of nitrifiers and the activity/cell. Experimentation using an in vitro measure of the nitrifying ability of the liquor defined the tolerance limits of nitrifiers to a variety of physical and nutritional conditions. (Zielinski-MAXIMA)
W82-05295

HEAT LOSS FROM RAPID INFILTRATION BASIN IN WINTER,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
H. G. Stefan.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 141-158, February, 1982. 7 Fig, 11 Ref.

Descriptors: *Infiltration, *Heat flow, Model studies, Basins, Groundwater, *Leaching, Percolation, Mathematical studies, Seasonal variations, Temperature effects, Economic aspects, Wastewater treatment, *Wastewater facilites.

A heat budget analysis is presented for a rapid wastewater infiltration/percolation basin to be operated at air temperatures below zero degrees C. In a rapid infiltration basin, the unchlorinated secondary effluent from a wastewater treatment plant is discharged onto the ground by flooding. Rapid infiltration basins return water to the groundwater table and provide a form of tertiary treatment. For small communities in cold climates, the year-round operation of infiltration basins without major storage requirement is economicaly attractive. The heat exchange processes associated with such a winter operation are analyzed herein with a view toward design applications. The analysis is theoretical and considers two modes of operation, one with a permanent ice cover on the basin and one without. The loading of the infiltration basin is intermittent. The analysis provides a complete heat budget. The equations are expressed in a form which permits estimation of frequency of loading of a basin as a function of loading depth. Heat losses to the atmosphere, formation of an ice cover, and cyclic freezing and thawing of the soil are included in the analysis. (Baker-FRC)
W82-05317

INTERNATIONAL NUTRIENT CONTROL TECHNOLOGY FOR MUNICIPAL EFFLUENTS,
Municipal Environmental Research Lab., Cincinnati, OH.
E. F. Barth, and H. D. Stensel.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1691-1701, December, 1981. 4 Fig, 8 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Nitrification, *Nitrogen removal, Nutrients, *Municipal wastewater, Cost analysis, Wastewater facilities.

The U.S. Environmental Protection Agency sponsored an 'International Seminar on Control of Nutrients in Municipal Wastewater Effluents' in September, 1980. This seminar reviewed nutrient control technology and needs for Canada, Japan, Sweden, Austria, Australia, Switzerland, and the United States. Design aspects, performance, operating characteristics, and costs associated with various full-scale systems for phosphorus removal, nitrification, and nitrogen removal were discussed. Chemical treatment is the most commonly used method for removing phosphorus from municipal wastewater, although biochemical and biological treatment systems are also in use. In some areas, laws requiring the use of low-phosphorus detergents reduce the costs of phosphorus removal. Full-scale nitrification systems discussed included single-stage and two-stage activated sludge nitrification systems and fixed-film processes such as plastic media trickling filters and rotating biological contactors. Full-scale nitrogen removal systems examined included oxidation ditch systems, and alternating aerobic and anoxic single-stage system, the Bardenpho system, a tertiary denitrication filter with methanol addition, a continuous-flow sequentially aerated activated sludge system, an overland flow system, and a clinoptilolite selective ion-exchange system. The capital cost and operating and maintenance costs for the facilities for removing phosphorus and nitrogen from wastewater varied over a wide range due to differences in design and operation and in effluent requirements. (Carroll-FRC)
W82-05321

INHIBITION OF NITROGENOUS BOD AND TREATMENT PLANT PERFORMANCE EVALUATION,
Iowa Univ., Iowa City. Coll. of Engineering.
R. E. Dague.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1738-1741, December, 1981. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Biochemical oxygen demand, *Wastewater facilities, *Nitrification, Wastewater treatment, *Performance evaluation, Secondary wastewater treatment, Effluent standards.

The importance of considering carbonaceous and nitrogenous oxygen demands separately in evaluating the performance of wastewater treatment plants is discussed. In several cases, state regulatory agencies and/or the U.S. Environmental Protection Agency have refused to accept the inhibited (carbonaceous) 5-day biochemical oxygen demand (BOD) test as the basis for interpreting plant performance. In these cases it is difficult, if not impossible, for treatment facilities achieving partial nitrification to meet the 5-day BOD performance criteria for secondary treatment (average 5-day BOD of 30 milligrams per liter). Treatment plants which are partially nitrifying will have nitrifying bacteria associated with the volatile suspended solids in the effluent. As a result, the effluent BOD will be increased due to nitrification occurring during the standard 5-day test. Although these treatment plants would actually be removing more total BOD, they would display a higher effluent 5-day BOD than plants treating an identical wastewater but not achieving partial nitrification. It is suggested that errors resulting from the use of the standard uninhibited BOD test may result in the selection of inferior treatment processes and systems or in the penalization of treatment facilities providing superior treatment through partial nitrification. (Carroll-FRC)
W82-05323

ECONOMICAL AND EFFICIENT PHOSPHORUS CONTROL AT A DOMESTIC-INDUSTRIAL WASTEWATER PLANT,
D. Van Dam.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1732-1737, December, 1981. 2 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Phosphorus removal, Wastewater facilities, *Municipal wastewater, Industrial wastewater, Activated sludge process, Operating costs, Grand Haven, Spring Lake, *Michigan.

The towns of Grand Haven and Spring Lake, Michigan, formed a combined sewer authority and began planning a new central wastewater treatment facility in 1968. The treatment plant was designed to process both domestic wastes and a substantial volume of wastewater from a chrome and vegetable tannery. The treatment plant employs grit removal, phosphorus removal, primary clarification, and activated sludge and chlorine contact and conditions solids thermally prior to vacuum filtration. The tannery contributes about 18% of the total flow, but 80% of the suspended solids and biological oxygen demand. Suspended solids and biological oxygen demand removals have consistently been above 90%. The final effluent phosphorus concentration has been under 1.0 milligrams per liter, representing removal rates over 80%. This successful control of phosphorus in the effluent has been achieved by adding waste pickle liquor to the primary settling tank. This waste pickle liquor is obtained from steel mills in Gary, Indiana. No flocculating aids are necessary. It is necessary to add much larger amounts of this

iron solution when the tannery wastes are limited or not present than when they are present in considerable amounts. As a result, analyses are made on daily composite wastewater samples, and the iron feed is adjusted based on the previous day's operating results. (Carroll-FRC)
W82-05324

THE USE OF CONTAINER-REARED CULTURES OF CLADOCERA IN POLISHING FISH FARM EFFLUENTS,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Prodovogo Rynogo Khoziaistva Rybnoe (USSR).
I. B. Bogatova, and Z. I. Yerofeyeva.
Hydrobiological Journal, Vol 16, No 5, p 56-61, 1980. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Zooplankton, *Biofilters, *Fish farming, Daphnia, Cladocerans, Wastewater treatment, Invertebrates, Biological treatment, Organic matter, Settling tanks.

Mesh containers of cladocerans were immersed in fish farm waste settling tanks to remove excess organic matter before discharging the effluent into receiving waters. Daphnia magna, Moina macrocopa, Ceriodaphnia reticulata, and D. magna plus C. reticulata were used in 5 to 11 containers per pond, arranged in checkerboard fashion or longitudinally. Best results were obtained with Daphnia magna in 10 containers arranged in checkerboard order. Settling tanks with zooplankton had lower levels (19.1-24.5%) of organic matter in the sediment than the control (27.5%). Total nitrogen content and total phosphorus content were lower in tanks with cladocerans. Ammonia-N was increased. Adding the cladocerans to the tanks without enclosing them in containers was unsuccessful because fish escaped from the farm ponds into the settling tanks and ate large quantities of cladocerans. (Cassar-FRC)
W82-05327

BACTERICIDAL AGENTS IN WASTEWATER LAGOONS AND LAGOON DESIGN,
Idaho Div. of Environment, Pocatello.
J. R. Moeller, and J. Calkins.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2442-2451, October, 1980. 5 Fig, 4 Tab, 27 Ref.

Descriptors: *Coliforms, *Ultraviolet radiation, *Design criteria, Bacteria, *Wastewater lagoons, Wastewater treatment, Lagoons, Chlorination, Disinfection, Irradiation, Hydrogen ion concentration, Activated sludge process, West Hickman Creek Wastewater Treatment Facility, *Kentucky.

A study was conducted at the West Hickman Creek Wastewater Treatment Facility, located on the Jessamine County-Fayette County line in Kentucky on West Hickman Creek. Treatment at this plant includes the Kraus modification of the activated sludge process, secondary treatment, four tertiary lagoons, and disinfection by chlorination just prior to discharge. The study was designed to determine more clearly the role of solar ultraviolet radiation in the destruction of coliform bacteria. Coliform concentrations were measured in each of the four lagoons. A close correlation between pH and coliform reduction was noted in earlier studies, but since the pH in the West Hickman lagoon system rarely exceeded 8.5, it is doubtful that this was a factor in coliform survival at this facility. Nutrient loading in terms of ortho-phosphorus, total phosphorus, and total Kjeldahl nitrogen remained essentially constant for the duration of the study, although total Kjeldahl nitrogen concentrations became erratic and increased by about 50% during the last 2 months of the study. Coliform densities were generally higher during winter than in summer. Declining doses of ultraviolet light in autumn may have partially contributed to the increase. It is also likely that the increase resulted from cessation of lagoon chlorination prior to initiation of the study. The data do, however, suggest the importance of ultraviolet light lethality to coliforms. A large and highly significant portion of the survival variance was correlated with ultraviolet dosage. Samples taken from low temperature waters exhibited greater destruction than can be reasonably explained by UV-B effects alone. (Baker-FRC)
W82-05333

RAPID-INFILTRATION RESEARCH AT FLUSHING MEADOWS PROJECT, ARIZONA,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, R. C. Rice, J. C. Lance, and R. G. Gilbert.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2457-2470, October, 1980. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Infiltration, *Wastewater treatment, Secondary wastewater treatment, Effluents, Water quality, Basins, *Flushing Meadows Project, *Arizona, Water reuse, Conservation, Water conservation, Nitrogen, Phosphorus, Phosphates, Nutrients, Acidity, Groundwater recharge.

During the first five years of the Flushing Meadows Project, the main objective was to maximize hydraulic loading and to determine the associated quality improvement of the effluent as it seeped down to the groundwater and moved laterally through the aquifer. During the second five years the research comprised studying maximization of nitrogen removal, which required a reduction in hydraulic loading. The Project consisted of six parallel, horizontal basins. Secondary wastewater effluent from an activated sludge process with no chlorination was pumped into the basins at one end. The 5-day BOD generally was in the 10 to 20 mg/l range for secondary effluent going into the infiltration basins, and less than 1 mg/liter for the renovated water from the East Center Well. Chemical oxygen demand of the secondary effluent was 30-60 mg/l, and that of the renovated water, 10-20 mg/l. Total nitrogen content of the secondary effluent normally ranged between 20 and 40 mg/l, with the low values occurring in the summer. Phosphorus in the secondary effluent was mostly in the orthophosphate form. Concentrations of phosphate-phosphorus showed a slightly decreasing trend in the 10 years of the research, from an average of about 11 mg/l in 1969 to about 8 mg/l in 1977. This decrease can probably be attributed to an increase in household use of low phosphate detergents. The fluoride concentration of the secondary effluent decreased during 1973-77 and averaged 20.8 mg/l in 1977. Boron concentrations averaged 0.45 mg/l in 1968 and increased to 0.85 mg/l in 1971, decreasing to 0.59 mg/l in 1977. The secondary effluent contained 21 PFU's/l; viruses could not be detected in renovated water sampled below the basins. (Baker-FRC)
W82-05334

VELOCITY DEPENDENCE OF PHOSPHORUS TRANSPORT IN A PACKED-BED REACTOR,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, B. R. McMahon, and R.-L. Chu.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2371-2376, October, 1980. 9 Fig, 4 Ref.

Descriptors: *Model studies, *Phosphorus, *Packed beds, Wastewater treatment, *Velocity, Phosphorus transport, Mathematical equations, Mathematical studies, *Packed-bed reactor, Phosphorus kinetics.

A model is presented that provides a quantitative correlation between phosphorus kinetics and velocity in a packed-bed reactor. The model includes the processes of dispersion, convection, adsorption, transformation, decomposition, and reaction. Dispersion was found to be negligible compared with other processes. Decomposition and reaction were both shown to be velocity dependent, and accounted for the shift of the midpoint with velocity and the dependence of the overall reaction, respectively. The net rate of formation of fixed phosphate showed a strong dependence on velocity, which established the strong coupling between the hydrodynamic and chemical processes. (Baker-FRC)
W82-05335

WASTEWATER FROM A SUGAR REFINING INDUSTRY,
Mosul Univ. (Iraq).
S. Ahmad, and T. A. Mahmoud.
Water Research, Vol 16, No 3, p 345-355, March, 1982. 11 Fig, 4 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Sugar crops, Beets, Sugarcane, Chemical oxygen demand, *Iraq, Chemical analysis, Water analysis, Water quality.

Wastewater was collected from a sugar factory in Mosul which refines raw sugar for most of the year, except for a maximum of 40 days when it processes beet sugar, depending on the availability. The factory has a production capacity of 2000 t/day of beet sugar, 600 t/day of white sugar and 300 t/year of bakery yeast. It also produces 24,000 tons of lime. The quantity of wastewater produced per ton of sugar refined is relatively high, perhaps due to the fact that the quantity of water available and its cost are not yet limiting factors. There was considerable variation in the characteristics of the wastewater. The possible variations should be considered when designing any treatment facility. The kinetic coefficients determined by inexpensive batch reactor studies could be helpful in obtaining estimates of design data. The mathematical model suggested by Eckenfelder is applicable to sugar refinery wastewater. The Tucek model is applicable to data based on chemical oxygen demand values. The performance relationship as suggested by Tucek can be used to predict the efficiency of chemical oxygen demand for a given set of conditions. (Baker-FRC)
W82-05337

ORGANIC POLLUTANTS ADSORPTION FROM MULTICOMPONENT SYSTEMS MODELED BY FREUNDLICH TYPE ISOTHERM,
Technion-Israel Inst. of Tech., Haifa. Div. of Environmental and Water Resources Engineering.
C. Sheindorf, M. Rebhun, and M. Sheintuch.
Water Research, Vol 16, No 3, p 357-362, March, 1982. 10 Fig, 1 Tab, 3 Ref.

Descriptors: *Isotherms, *Mathematical equations, Temperature gradient, Thermocline, Langmuir isotherm, Freundlich isotherm, *Adsorption, Uptake, *Wastewater treatment.

A novel Freundlich-type multicomponent adsorption isotherm has been used to describe adsorption data in multicomponent systems. This isotherm is suitable for multicomponent systems that consist of components which obey a Langmuir isotherm when present as a single component. The isotherm was used to describe the adsorption of parabromophenol, phenol and benzensulfonate on activated carbon from the respective bicomponent and three-component aqueous solutions. This method demonstrated superiority over the commonly employed miltisection Langmuir isotherm. (Baker-FRC)
W82-05338

PH INFLUENCE ON ACIDOGENIC DISSIMILATION OF GLUCOSE IN AN ANAEROBIC DIGESTOR,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
R. J. Zoetemeyer, J. C. Van Den Heuvel, and A. Cohen.
Water Research, Vol 16, No 3, p 303-311, March, 1982. 7 Fig, 9 Tab, 18 Ref.

Descriptors: *Anaerobic digestion, *Acidity, *Wastewater treatment, Biodegradation, Bacteria, Anaerobic bacteria, Digestion, Activated sludge process, *Hydrogen ion concentration, Glucose.

The influence of the pH value on acidogenesis was investigated with reference to maximum specific growth rates and product distributions at various delution rates in order to optimize product distribution with respect to the more sensitive methanogenic stage. Glucose was used as the carbon limiting substrate, since its acidogenesis was rate limiting in the continuous flow stirred tank reactor (CFSTR). The gas phase consisted of carbon dioxide and hydrogen. Recovery of dissolved products,

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mainly short-chain fatty acids, gas and biomass, calculated as total carbon, amounted to 85-95%. Yield values ranged from 12 to 14%. An optimal growth rate of 0.33/hr was achieved at a pH of 6.0. Product distrubution at 90% of the maxiumum growth rate was fairly constant up to the pH value of 6.0, after which dramatic changes in the main product were found to occur, from butyric acid to lactic acid and subsequently to acetic acid, formic acid and ethanol. (Baker-FRC)
W82-05341

INDUSTRIAL WASTEWATER TREATMENT TECHNOLOGY--RECENT DEVELOPMENTS,
Vanderbilt Univ., Nashville, TN.
W. W. Eckenfelder, Jr.
Water Science and Technology, Vol 14, No 1/2, p 111-119, 1982. 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Industrial wastewater, *Organic compounds, *Activated carbon, *Wastewater treatment, Technology, Activated sludge process, *Heavy metals, Adsorption, PACT process, Oxidation, Nitrification, Dentrification, Economic aspects, Costs.

Conventional treatment of industrial wastewaters is concerned with removal of BOD, suspended solids and certin specified pollutants: nitrogen, phosphorus, heavy metals, cyanide, and phenol. Recent legislation will require control of toxic organics and color in addition to the above pollutants. Emphasis is presently directed toward in-plant control technology or modifications of conventional technology. Some examples of source control are: precipitation of heavy metals followed by filtration or ion exchange if necessary, organics removal by oxidation using ozone or hydrogen peroxide with or without ultraviolet light or catalysts, adsorption on granular activated carbon or macroreticular resins, and air or steam stripping of volatile pollutants. In DuPont's PACT process powdered activated carbon is added to the activated sludge process. This results in improved removal of non-biodegradable organics and priority pollutants, especially under shock loads, dampening of effluent variability, improved hydraulic capacity, and enhanced nitrification. The performance characteristics of the PACT process are listed for several types of municipal and industrial wastewaters. PACT dosages ranged from 125-310 mg per liter. Economics of several treatment systems are compared for plants of 1, 10, and 50 mgd capacity. Lowest costs were activated sludge with solids handling and rotating biological contactors with solids handling; intermediate were activated sludge with 2-stage nitrification and solids handling and PACT with and without nitrification plus solids handling, regeneration, and carbon makeup; highest was physical chemical treatment with granular activated carbon. (Cassar-FRC)
W82-05348

WASTEWATER TECHNOLOGIES IN SOUTH AFRICA: RESEARCH AND APPLICATION,
Water Research Commission, Pretoria (South Africa).
G. J. Stander, G. G. Cillie, E. J. Hall, and M. R. Henzen.
Water Science and Technology, Vol 14, No 1/2, p 465-480, 1982. 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Research priorities, *Water reclamation, *Advanced wastewater treatment, Technology, Wastewater treatment, Industrial wastewater, Water reuse, Reverse osmosis, *South Africa, Public health, Water quality, Nutrient removal, Textile mill wastes, Pulp and paper industry, Ponds, Algae, Ultrafiltration, Ion exchange, Color removal, Dyes, Bardenpho process, Phosphorus removal, Phoredox process, Sludge treatment, Monitoring, Pollutant identification, Viruses, Carcinogens, Potable water.

Highlights of recent research and applications in South Africa cover water and wastewater management and water reuse. Potable water is produced at Windhoek, Namibia, by treating maturation pond effluent with high lime clarification, foam fractionation, clarification, breakpoint chlorination, activated carbon adsorption, and free residual chlorination. Quality control includes monitoring of volatile halogenated hydrocarbons and epidemiological studies. Municipal water reclamation plants are operated at Pretoria and Cape Town. Water reuse plants at two paper mills produce good guality effluents. Reverse osmosis, effective in removing accumulated inorganic salts, is currently under investigation. The Bardenpho process was a result of studies to remove nutrients without chemical addition. It consists of four stages--primary anoxic, primary aerated, secondary anoxic, and secondary aerated--followed by clarification. Organic matter in the wastewater is the sole carbon source. The Phoredox process is a refinement of the Bardenpho process. About 30 plants using these processes are presently operating in South Africa. Research on handling of the dilute sludge has tried dissolved air flotation, belt filters, centrifuges, polyelectrolytes, and land application. Nitrogen removal from an industrial effluent is being studied in a system of algae ponds with decreasng depth. (Cassar-FRC)
W82-05350

CRITERIA FOR NITRIFICATION IN FIXED FILM REACTORS,
Technical Univ. of Denmark, Copenhagen. Dept. of Sanitary Engineering.
P. Harremoes.
Water Science and Technology, Vol 14, No 1/2, p 167-187, 1982. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Nitrification, *Oxygen, *Ammonia, *Wastewater treatment, Biological treatment, Model studies, Organic matter, Dissolved oxygen, Trickling filters, Contact filters, Aerobic conditions.

A hypothesis concerning nitrification in fixed films, analytically modeled under simplified assumptions, agreed qualitatively with data from the literature. The postulation was that nitrification in fixed films can be achieved only when nitrifying bacteria embedded in a biofilm surface of mineralizing bacteria have sufficient exposure to aerobic conditions to multiply and reach concentrations high enough to convert ammonia. Several cases are considered: (1) the entire thickness of the biofilm is aerobic, (2) ammonia cannot fully penetrate the biofilm, (3) oxygen cannot fully penetrate the biofilm, (4) oxygen and ammonia fully penetrate the biofilm, and (5) the penetration of oxygen is greater than the penetration of ammonia. Oxygen penetrates deeper into the biofilm than soluble organic matter. In practice the soluble BOD should be limited to 20 mg per liter for 3 mg per liter dissolved oxygen. (Cassar-FRC)
W82-05352

HIGH-RATE ALGAE PONDS FOR WASTEWATER TREATMENT AND PROTEIN PRODUCTION,
Technion-Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
G. Shelef.
Water Science and Technology, Vol 14, No 1/2, p 439-452, 1982. 3 Fig, 2 Tab, 31 Ref.

Descriptors: *Algae harvesting, *Wastewater lagoons, *Feeds, *Wastewater treatment, Biomass, Algae growth, Photosynthesis, Nutrient removal, Bacteria, Proteins, Ponds, Lagoons, Productivity, *Israel.

Work on municipal wastewater treatment in high rate algae ponds (HRAP) began in Israel in 1968. This paper summarizes results of the 1975-80 period. Total biomass yields of 35-50 g per sq m per day or over 180 metric tons (dry) of mixed biomass per ha per year may be obtained with these systems. Bacterial productivity is fairly constant at about 20 g per sq m per day throughout the year. Algal productivity ranges from 10 g per sq m per day in winter to over 30 g per sq m per day in summer. The system is composed of a photosynthetic mixed meandering channel type pond 20-60 cm deep. Mixing is provided by paddle wheels or cage aerators to produce a longitudinal velocity of 5-10 cm per sec. The algal harvesting and processing units thicken, dewater, and dry the biomass for use as animal feed. Effluent is polished in an intermittent shallow coarse sand filter and chlorinator. Complete data are given for 12 months operation of a pilot pond using raw municipal wastewater from Haifa, Israel. This 120 sq m pond produced 1935 kg biomass (dry) in the 12 months starting September 1978. Effluent under favorable conditions averaged < 10 mg per liter total suspended solids, < 10 mg per liter total BOD, 50 mg per liter total COD, 24 mg per liter total N, < 0.5 mg per liter total P, and 100 per 100 ml total coliforms. Since no fertilizers, carbon source, pond liners, or axenic cultures are needed, production costs for the algal biomass are only $80 per ton sundried or $120 per ton drum dried after costs of secondary wastewater treatment have been deducted. (Cassar-FRC)
W82-05355

DESIGN AND OPERATION INTERACTION--AN EXAMPLE: MAIN TREATMENT PLANT VIENNA,
Technische Univ., Vienna (Austria).
W. von der Emde.
Water Science and Technology, Vol 14, No 1/2, p 493-506, 1982. 3 Fig, 9 Tab, 10 Ref.

Descriptors: *Activated sludge process, *Sludge disposal, *Municipal wastewater, *Wastewater treatment, Incineration, Pilot plants, Biological wastewater treatment, Design criteria, Aeration, *Vienna, Austria.

The Main Treatment plant in Vienna, Austria, uses the high-rate activated sludge process (1.2 days sludge age and 1.5 hour hydraulic detention time). To minimize construction and operating costs four large aeration tanks of 10,000 cu m capacity each were installed. A plug flow mixing regime was specified. Aeration motors are direct-current so that speed may be easily decreased during periods of low oxygen demand. Sludge is incinerated with spent oil and garbage after dewatering and drying. Average wastewater flow in March 1981 was 656,400 cu m per day; influent COD, 756 mg per liter; influent BOD5, 323 mg per liter; effluent COD, 90 mg per liter; and effluent BOD5, 31 mg per liter. Overall removal efficiencies were COD, 88%; and BOD5, 90%. Details are given of the 16-year design, pilot plant, and full-scale studies that preceded the plant startup in October 1980. (Cassar-FRC)
W82-05356

FLUID FLOW PATTERN IN UPFLOW REACTORS FOR ANAEROBIC TREATMENT OF BEET SUGAR FACTORY WASTEWATER,
Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
P. M. Heertjes, L. J. Kuijvenhoven, and R. R. van der Meer.
Biotechnology and Bioengineering, Vol 24, No 2, p 443-459, February, 1982. 11 Fig, 3 Tab, 7 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Flow pattern, Anaerobic digestion, Food-processing wastes, Wastewater facilities, Design criteria, Pilot plants, Prototypes, Beets, *Beet sugar industry.

The fluid flow pattern of a 30 cubic meter upflow reactor used for the anaerobic treatment of wastewater from a beet sugar factory was studied. The prototype 200 cubic meter reactor was constructed based on the results of experiments with the pilot reactor. Residence time distribution experiments were conducted in the prototype reactor using continuous injection of a lithium chloride (LiCl) solution as a tracer in the influent of the reactor and measuring the response to this stimulus at several locations in the reactor and in the effluent. These measured data were used to develop models of the fluid flow pattern which consisted of regions of ideal mixing, plug flow, dead space, and short circuiting. Comparisons of the fluid flow patterns of the pilot plant and the prototype indicated that three-mixer models were appropriate for the pilot plant, while two-mixer models were found for the prototype. The studies found that, at the influent concentrations and liquid residence times applied, the gas produced by the anaerobic bacteria provided good mixing of the fluid inside

the reactor. However, the settler on top of the reactor must be effectively shielded from the region in the reactor where the anaerobic conversion takes place. Dead space regions may be created by high concentrations of mud in the blanket, which cause extra thickening of the suspended solids in the bed. Experiments with the prototype reactor showed that upflow reactors for anaerobic treatment of wastewater should contain enough sludge to provide a sludge bed height of between 1.5 and 2.5 meters. Most of the influent bypassed the sludge bed at bed heights of 0.4 meters. (Carroll-FRC)
W82-05372

CARBON LIMITATION OF BIOMASS PRODUCTION IN HIGH-RATE OXIDATION PONDS,
Technion-Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
Y. Azov, G. Shelef, and R. Moraine.
Biotechnology and Bioengineering, Vol 24, No 3, p 579-594, March, 1982. 7 Fig, 5 Tab, 16 Ref.

Descriptors: *Photosynthesis, *Algal growth, *Carbon dioxide, *Oxidation ponds, Ponds, Wastewater ponds, Growth rates, Organic loading, *Wastewater treatment, Biomass, High rate oxidation ponds, *Israel.

Carbon was the limiting factor in biomass production in high rate wastewater oxidation ponds. This conclusion was reached by theoretical considerations and by field experiments performed near Haifa, Israel. The main contributor to algal photosynthesis was the dissolved carbon dioxide provided by bacterial degradation of the organic compounds in the wastewater. Atmospheric carbon dioxide was a minor contributor under conditions of high organic loading but was significant at low organic loadings. Adding carbondioxide gas to a pond during a period of high organic matter concentrations did not increase photosynthesis. Shallower ponds became carbon limited more quickly than deeper ponds. Addition of bicarbonate did not increase algal growth as did carbon dioxide. (Cassar-FRC)
W82-05373

KINETICS OF BIOFILM NITRIFICATION,
Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Technisch-Chemisches Lab.
H. Tanaka, and I. J. Dunn.
Biotechnology and Bioengineering, Vol 24, No 3, p 669-689, March, 1982. 17 Fig, 11 Tab, 14 Ref.

Descriptors: *Nitrification, *Kinetics, *Biofilms, *Wastewater treatment, Oxidation, Ammonium, Nitrites, Oxygen, Chemical reactions, Model studies, Nitrosomonas, Nitrobacter.

Reaction rates of the two-step nitrification reaction (ammonia oxidation followed by nitrite oxidation) were studied in a fluidized sand bed biofilm reactor. Under low NH4+ concentrations, when the oxygen/NH4+ ratio in the bulk liquid was less than the stoichiometric coefficient (3.4 mg per mg), oxygen was rate limiting. Under low oxygen conditions the nitrite oxidation rate was lower than the NH4+ oxidation rate, leading to an accumulation of nitrite. pH had little effect on biofilm nitrification kinetics. Organic carbon oxidation in the biofilm reduced NH4+ and nitrite oxidation rates. The influence of oxygen penetration effects on the relative values of NH4+ and nitrite oxidation rates was caused either by the Nitrobacter location in the inner biofilm regions or by a saturation effect for oxygen. A differential diffusion-reaction model was used to simulate the experimental results. (Cassar-FRC)
W82-05374

WESTCHESTER COUNTY'S PEEKSKILL WASTEWATER TREATMENT PLANT REPLACES FIVE PLANTS,
W. G. Borghard, and W. B. Sinnott.
Clearwaters, Vol 11, No 4, p 11-14, December, 1981. 1 Fig, 2 Tab.

Descriptors: *Wastewater facilities, *Complete wastewater treatment, Water treatment facilities, Wastewater treatment, Wastewater management, Computers, Aeration lagoons, Activated sludge process, Sludge, Advanced wastewater treatment, *Westchester County, *New York.

After the energy crisis of 1973, a re-study of a proposed sludge disposal method was undertaken by the Westchester County Department of Environmental Facilities for the Peekskill Sanitary Sewer District. The study indicated that thickening, anaerobic digestion, utilization of methane gas, dewatering by centrifugation, and disposal through composting and/or landfill were the most economical processes; the original design was revised accordingly. New secondary treatment facilities utilize the activated sludge process with diffused air. The plant is designed for 10 MGD with provision for expansion to 15 MGD. Pretreatment of incoming flow causes it to pass through mechanically cleaned bar screens and then to grit chambers. Four primary settling tanks begin the primary treatment, and effluent from these tanks flows into secondary treatment by pipeline into aeration tanks. Mixed liquor flows to any of four final settling tanks. Chlorine is applied to the final effluent through a diffuser located immediately ahead of the plant effluent conduit. The final effluent discharges through diffusers in the ship channel of the Hudson River after passing through an outfall. Raw sludge is pumped from two combined sludge gravity thickeners by pumps to the primary digester. Dewatering is accomplished through the use of centrifuges. A UCS 3000 computer receives, records, totalizes, and prints all the analog data as well as the alarm status of over 110 items. Start-up of the sludge digestion process by filling the primary tank with a mixture of raw sludge and wastewater was not successful. The process was successfuly restarted with seed sludge trucked in from another Westchester County plant. (Baker-FRC)
W82-05399

CONVERSION OF AERATOR TO CHLORINE CONTACT TANK AT THE OWLS HEAD WATER POLLUTION CONTROL PLANT,
New York City Environmental Protection Administration.
J. J. Donnellon, and D. Katz.
Clearwaters, Vol 11, No 1, p 14-19, March, 1981. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater facilities, *Chlorination, Aeration, Disinfection, Design criteria, Water pollution control, Chlorine, *Owls Head Treatment Plant, *New York, *Water treatment.

A chlorination problem at the Owls Head Water Pollution Control Plant was solved by converting an idle aerator, which was situated adjacent to the plant effluent channel, to a chlorine contact tank. While the merit of this solution was immediately obvious, once suggested, in 1975, it was not recognized during long study and experimentation sessions, which were conducted from 1969 on. The major problem with the old chlorination system was a lack of sufficient contact time; it was decided to chlorinate in the final sedimentation tanks which would provide a detention of 68 minutes, as opposed to the previous 10 minute contact. The system of final tank disinfection, however, had several serious disadvantages. Although it did afford a long detention, it did not provide adequate mixing, and the chlorine demand was excessive due to the suspended solids in the final tanks. Thus it was necessary to dose at the rate that ranged from 80 to 100 gallons per M.G. The system was also dependent on stable final tank operation, and several of these failed during 1973. The two essential components in an efficient chlorination are contact time and mixing. The conversion the idle aerator at Owls Head provides an excellent example of the potential for improvement that may reside in existing plant facilities. (Baker-FRC)
W82-05402

USE OF SYNTHETIC ADSORBENTS IN CHEMICAL PROCESSES,
Rohm and Haas Ltd., Croydon (England).
R. M. Carlyle.
Effluent and Water Treatment Journal, Vol 22, No 2, p 55-59, February, 1982. 7 Fig, 4 Tab.

Descriptors: *Polymers, *Adsorbents, *Absorption, *Advanced wastewater treatment, *Organic compounds, *Tertiary wastewater treatment, Separation techniques, Wastewater treatment, Activated carbon, Pesticides, Organic solvents, Organic pesticides, Industrial wastes, Water treatment.

Some applications and properties of synthetic polymeric adsorbents are reviewed with special focus on the use of Amberlite synthetic adsorbents for the removal of organic compounds during water and wastewater treatment. The Ambersorb adsorbents have properties similar to those of activated carbon. The concentration of adsorbate solution, solution pH, and regeneration during the adsorption process influence the efficiency of absorption. Chemical regeneration, polar solvents regeneration, and stream regeneration are described. Phenol can be recovered from the effluents of bisphenol-A production by a solvent regeneration process which yields a production effluent with < 10,000 ppm of phenol and non-polar solvents. Phenol may also be recovered from cumene by the cumene process and from phenol-formaldehyde resin using a Grignard reaction. Similar methods are used for the recovery of pesticides of the substituted phenol or phenoxy acid type from their production wastewaters. When using synthetic adsorbents for the removal of ethylene dichloride from the production effluents of vinyl chloride and the removal of benzene, toluene and xylene from refinery effluents, steam regeneration processes yield an effluent of high quality. (Geiger-FRC)
W82-05404

UPRATING SLUDGE DIGESTERS BY IMPROVING THE HEAT TRANSFER OF HEATAMIX UNITS,
Severn-Trent Water Authority (England).
J. Upton, and R. Schofield.
Effluent and Water Treatment Journal, Vol 21, No 12, p 538-540, December, 1981. 2 Fig.

Descriptors: *Sludge digestion, *Heat transfer, *Fouling, Heatamix units, *Leicester, *England, Anaerobic digestion, Digestion, Mixing, Sewage gas, Energy conservation, Performance evaluation, Flow pattern, Alteration of flow, Direct flow.

Poor performance in anaerobic sludge digestion tanks at the City of Leicester's Wanlip works was attributed to fouling of the heat exchange surfaces and inadequate design of the Heatamix units, which heat and mix the sludge. The units were operating with a heat transfer coefficient of 694 KJ per sq m per degree C per hour, 70% of the design figure. Since it was impractical in this case to change the gas flow rate, water flow rate, or water temperature, the Heatamix units were converted to a co-current flow arrangement. The pipe system was reversed so that the conventional water flow was reversed, hot inlet water was pumped to the bottom, and cooler water left from the top. Modification of the units increased the heat transfer coefficient to 1000 KJ per sq m per degree C per hour. (Cassar-FRC)
W82-05405

DOES CONVENTIONAL SEWAGE TREATMENT MEET THE DEMANDS OF THE 1980'S,
K. Stendahl.
Effluent and Water Treatment Journal, Vol 22, No 2, p 61-65, February, 1982. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Biological wastewater treatment, *Chemical precipitation, *Cost analysis, *Advanced wastewater treatment, *Phosphorus removal, Wastewater treatment, Chemical treatment, Phosphorus, Separation techniques, Physicochemical treatment, Filtration, Tertiary wastewater treatment, Evaluation, Standards.

The design and construction of sewage treatment facilities often follow conventional patterns based on increased demands and economic feasibility. Primary treatment mechanically removes coarse pollutants by screening and sedimentation. Secondary biological treatment breaks down organic pollutants. Phosphorus elimination is achieved by chemical precipitation during tertiary treatment. A fourth stage, filtration, may also be used for sensi-

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tive receiving waters. Chemical precipitation is also useful in removing biochemical oxygen demand, heavy metals, and other contaminants in wastewater. Experience in Sweden shows that biological treatment is better than chemical precipitation for the removal of BOD. A cost breakdown for the four treatment stages for various plant sizes based on the 1979 cost level in Sweden is given. Costs can be reduced if the biological stage is replaced by chemical precipitation in a two stage process, and if mechanical and chemical precipitation are combined in a single process. An English study estimated the energy cost to be 1.3 dollars-person/yr for biological treatment or 0.1 dollars-person/yr for chemcial treatment. A two stage plant which combines mechanical and chemical treatment can reduce the energy costs in the biological stage by about 33%. In the 1970s many plants in Norway introduced chemical precipitation processes to reduce phosphorus discharge to Lake Mjosa. A new sewage treatment plant planned for Oslo will be based on primary precipitation. (Geiger-FRC)
W82-05407

PHOSPHORUS REDUCTION STUDIES,
A. V. Gray.
Effluent and Water Treatment Journal, Vol 22, No 2, p 68-71, 73, 74, February, 1982. 5 Fig, 20 Ref.

Descriptors: *Phosphorus removal, *Chemical precipitation, *Eutrophication, *Advanced wastewater treatment, Wastewater treatment, Phosphorus, Nutrients, Sulfates, Biological wastewater treatment, Lime, Tertiary wastewater treatment, Separation techniques, Activated sludge, *Lough Neagh, *Northern Ireland.

Phosphorus enrichment in Lough Neagh, Northern Ireland has been occurring since about 1900 with the advent of the water closet and use of artificial fertilizers. Various measures were tried to control eutrophication caused by massive blooms of Anabaena flos-aquae. Temporary measures to control algal growth included harvesting of weeds or introducing grazing organisms. More permanant measures of nutrient reduction include flow diversion or dilution and chemical precipitation which are often performed at discharge or manufacturing sources. Phosphorus entering sewage treatment works comes from household detergents, human excreta, and industrial sources. Influent sewage can contain phosphorus in many forms. Some phosphorus is removed during normal sewage treatment processes. The Bardenpho process can remove up to 85% of the phosphorus under strict operating conditions. Chemical precipitation of phosphorus combined with mechanical dosing provides efficient removal of phosphorus from wastewaters. Split-effluent lime processing is advocated for achieving phosphorus reduction by treatment of secondary effluent during biological filtration. Operation of a ferrous sulfate dosing plant should prove the economic value of this method of phosphorus reduction at activated sludge plants. Other wastewater treatment plants in the Lough Neagh catchment area are scheduled to be installed in the near future to reduce phosphorus loading to this lake. (Geiger-FRC)
W82-05408

RE-EXAMINING THE KINETICS OF THE BIOCHEMICAL OXIDATION OF SEWAGE,
T. Stones.
Effluent and Water Treatment Journal, Vol 22, No 2, p 75, February, 1982. 1 Tab, 7 Ref.

Descriptors: *Kinetics, *Oxidation, *Dissolved oxygen, *Biochemical oxygen demand, *Wastewater, Mathematical equations, Nitrification, Wastewater treatment, Biological wastewater treatment, Mathematical studies, Ammonia, Domestic wastes, Sewage.

The oxidation of sewage occurs spontaneously when it is diluted with clean aerated water. In this two stage process, the carbonaceous matter is first oxidized over a period of 15 to 20 days, and the second stage consists of the oxidation (nitrification) of original ammonia and that produced during the first stage. The kinetics of the carbonaceous stage follow a second order reaction whose rate depends on the biochemical oxygen demand (BOD) and the residual dissolved oxygen (DO) concentration. An equation was given for the kinetics of the first stage oxidation for a .01 dilution of settled domestic sewage at 20 degrees. By using a value of 6.00 milligrams/liter as the total BOD, the biochemical oxidation of sewage closely conforms to a second order reaction with a mean velocity coefficient of 0.039 for most of the first stage. These findings show that the decreasing rate of oxidation as the first stage proceeds is governed by the conjoint effect of consequential reductions in the residual dissolved oxygen level and the unsatisfied carbonaceous BOD. (Geiger-FRC)
W82-05409

OPERATION AND PERFORMANCE OF A NEW ACTIVATED SLUDGE PROCESS: THE CONTACT STABILIZATION EXTENDED AERATION HYBRID,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. H. Paepcke, and P. H. Jones.
Water Science and Technology, Vol 14, No 1/2, p 367-380, 1982. 10 Fig, 5 Tab, 8 Ref.

Descriptors: *Activated sludge process, *Contact stabilization, *Aeration, Biological wastewater treatment, Wastewater treatment, Municipal wastewater.

A hybrid activated sludge process combined the contact stabilization process and the conventional extended aeration process. Data obtained at a full-scale municpal wastewater treatment plant showed that the hybrid process had advantages of both components. Process stability was good because the sludge in the stabilization tank was not exposed to shock loads as in the conventional plant. The total aeration period was 6 hours vs. 24 hours for the conventional process. Large variations in hydraulic and organic loadings were handled without upset using a smaller, less expensive aeration tank volume. Effluent quality was consistently good. Only occasionally did BOD or suspended solids concentrations exceed 6 mg per liter. The food: microorganisms rations, 0.01-0.08 kg BOD per kg of volatile suspended solids per day, were in the low range characteristic of the extended aeration process. For a plant treating stronger wastewaters, longer detention times would be required. (Cassar-FRC)
W82-05417

LAND EXTENSIVE PROCESSES FOR WASTEWATER TREATMENT AND DISPOSAL--A PERSPECTIVE,
Water Science Lab., Melbourne (Australia).
C. D. Parker.
Water Science and Technology, Vol 14, No 1/2, p 393-406, 1982. 35 Ref.

Descriptors: *Wastewater irrigation, *Wastewater lagoons, *Land application, Irrigation, Lagoons, Ponds, Melbourne, Werribee, Australia, Wastewater composition, Water pollution effects, Soil properties, Agriculture, Water reuse, *Wastewater treatment, Pastures, Odor control, Heavy metals, Metals, Accumulation, Organic compounds, Pathogens, Public health, Groundwater pollution, Tertiary wastewater treatment, Fate of pollutants, *Wastewater disposal.

Land extensive wastewater treatment processes (ponds/lagoons and irrigation) have been used by the cities of Melbourne and Werribee, Australia, and in other countries. These experiences have led to conclusions helpful to planners of land extensive systems. Flat or slightly sloping ground is best for irrigation; ponds can tolerate up to 10-20% slope. Tight clay soil is best for pond sides and bottoms, although seepage always eventually stops due to sealing with sludge and algal matter. Very permeable soil spreads viable pathogens rapidly. Soils differ in ability to retain nutrients and heavy metals. There must be a compromise between the goals of maximum crop yield and maximum wastewater disposal. Irrigation methods must be adapted to the crop grown. The composition of the wastewater, whether domestic, industrial, or mixed, must be considered. Objectives of the land extensive systems may be complete treatment of raw waste, secondary or tertiary treatment, disposal of final effluent, or reuse of final effluent. Possible adverse effects of lagoon systems are unpleasant odor, groundwater contamination, and high concentrations of algae in the effluent. Irrigation schemes may cause accumulation of heavy metals and bioresistant organics in the soil, transmission of pathogens, sewage sickness on pasturelands, and groundwater pollution. Options are available to minimize the effects of the above problems. (Cassar-FRC)
W82-05419

AMMONIA AND TOTAL KJELDAHL NITROGEN REMOVAL IN AERATED LAGOONS,
Utah State Univ., Logan. College of Engineering.
A. Pano, and E. J. Middlebrooks.
Water Science and Technology, Vol 14, No 1/2, p 381-391, 1982. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Nitrogen removal, *Wastewater lagoons, *Temperature effects, *Kjeldahl procedure, Detention times, Ammonia, Wastewater treatment, Aerated lagoons, Lagoons, Hydraulic loading, Aeration, Performance evaluation, Seasonal variation, Nitrification, Comparison studies, Oklahoma, Wisconsin, Mississippi, Illinois, Pennsylvania.

Five aerated lagoons located in Oklahoma, Wisconsin, Mississippi, Illinois, and Pennsylvania were monitored for ammonia-N and total Kjeldahl nitrogen (TKN) removal. The lagoons differed in climatic conditions and in wastewater compositions. Mean annual ammonia-N and TKN removals were 49-94% and 50-87%, respectively, except for the Pennsylvania system, which had zero ammonia-N and TKN removal. The percentage removals of ammonia-N and TKN increased with decreases in hydraulic loading rates and increases in detention time. Removals in summer months were 10-20% higher than in winter. Differences in performance were observed between surface-aerated lagoons and lagoons with diffused-air aeration systems. Temperature differences, rather than type of equipment, were the likely causes of these differences. Less than 45 days hydraulic retention time or more than 0.055 cu m per sq m per day resulted in no ammonia-N or TKN removal. There was no relationship between dissolved oxygen concentration and percentage TKN and ammonia-N removals. (Cassar-FRC)
W82-05420

ELECTROCHEMICAL PROCESSES FOR WASTEWATER TREATMENT,
Naples Univ. (Italy). Dept. of Sanitary Engineering.
L. Mendia.
Water Science and Technology, Vol 14, No 1/2, p 331-344, 1982. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Electrochemistry, *Phosphate removal, *Tertiary wastewater treatment, *Wastewater treatment, Electrolysis, Seawater, Chlorination, Disinfection, Flocculation, Clarification, Electrodes, Magnesium hydroxide.

An electrochemical treatment of wastewater-seawater mixtures, especially useful in coastal communities, is described. After bar screening and grit removal the sewage is mixed with seawater at ratios of 1:3 or 1:4. The mixture passes through an electrolysis cell at retention times of 5-20 sec. The effluent is sent to a clari-flocculator basin where sedimentation of suspended solids and disinfection occurs during a 60-90 min retention period. Sludge from the process can be recirculated because of its high chlorine content and need not be digested. Chemicals used in treatment are generated from the electrolysis process. Hydrogen, chlorine, and hydroxyl ions are produced at the electrode and further react with each other and seawater constituents to form flocculant (magnesium hydroxide) and disinfectants hypochlorite). Advantages of the electrochemical treatment are no chemical costs, small plant size, recovery of metals if desired, and good phosphate removal. In this study the electrolytic cell was made of 6 contiguous perforated silicon-iron blocks (anode) and six contiguous per-

forated sheet irons (cathode). Operating parameters were: current density, 200 A; anodic current density, 1.33 A per sq dm; potential difference, 4V; energy consumption, 0.53 kWh per cu m; and feed flow, 2000 liters per hour. Suspended solids removal was 97%; BOD removal, 57% and phosphates removal, 86%. (Cassar-FRC)
W82-05422

CONTROL OF BULKING SLUDGE--PRACTICAL EXPERIENCES IN AUSTRIA,
Technische Univ., Vienna (Austria).
N. F. Matsche.
Water Science and Technology, Vol 14, No 1/2, p 311-320, 1982. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Sludge bulking, *Activated sludge process, *Wastewater treatment, Sludge volume index, *Austria, Filamentous organisms, Bacteria, Chlorination, Oxidation, Technology, Anaerobic conditions, Formaldehyde, Nutrients, Settling velocity, Organic loading, Flow patterns, Plug flow, Food-processing wastes, Ferrous sulfate, Polyelectrolytes.

In Austria experience with bulking sludge control has been successful with several methods: increase in specific weight of the floc, damage to the filamentous organisms, removing conditions favoring growth of filamentous organisms, and producing conditions adverse to growth of filamentous organisms. The specific weight of the floc may be increased by omitting the primary sedimentation step, reducing the concentration of polyelectrolytes so that soil particles are later incorporated onto the floc, or adding ferrous sulfate. Chlorination successfully inhibits filamentous organism growth. Formalin at 100 mg per liter is detrimental to both filamentous bacteria and nitrifying organisms but not to sludge bacteria. Factors which favor growth of filamentous organisms are septic conditions and nutrient deficiencies. These may be minimized by adequate flow velocities, frequent sludge removal, lower organic loads, and nutrient additions. Processes can be modified to produce conditions adverse to filamentous organism growth: use of intermittent feeding, increase in denitrification, division of the aeration tank into small compartments to cause plug flow conditions, and installation of a contact tank ahead of the aeration tank. (Cassar-FRC)
W82-05423

EXPERIENCE FROM 10 YEARS ADVANCED WASTEWATER TREATMENT--TECHNOLOGY AND RESULTS,
Uppsala Univ. (Sweden). Dept. of Limnology.
C. Forsberg, B. Hawerman, and B. Hultman.
Water Science and Technoloy, Vol 14, No 1/2, p 121-133, 1982. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Advanced wastewater treatment, *Phosphorus removal, *Chemical precipitation, Wastewater treatment, *Sweden, Eutrophication, Lakes, Nitrogen removal, Lake restoration, Heavy metals, Alum, Iron compounds, Coagulation, Nitrification, Chemical treatment, Technology.

Sweden's Environmental Protection Act of 1969 precipitated intensive construction of municipal wastewater plants during the 1970's. About 74% of the urban population is served by wastewater treatment plants with a combined biochemical and chemical treatment. The effluent goals are 15 mg per liter BOD7 and 0.5 mg per liter phosphorus. In certain cases more stringent standards are imposed. About 70% of the plants meet the requirements. In 1977 post-precipitation was used at 554 plants, direct precipitation at 138, pre-precipitation at 17, and simultaneous precipitation at 35. Aluminum sulfate was used at 600 plants, iron salts at 92 plants, and lime or combinations at the remainder. In the post-precipitation method several procedures are used to improve P removal and lower costs of chemical additions: 2-stage precipitation, recirculation of post-precipitation sludge to the activated sludge aeration basins, or biological P removal. Most of the 22 lakes evaluated have responded to the advanced wastewater treatment with lowered concentrations of P and organic matter. Half of these had lower chlorophyll a values and 6, significant increases in transparency. Heavily polluted lakes will not show decreases in chlorophyll until P concentration is decreased to less than 0.1-0.2 g per cu m. Nitrogen increased in 10 lakes and decreased in 4 lakes. Improvement is easier to achieve in deep stratified waters than in shallow vegetated lakes. (Cassar-FRC)
W82-05424

WATER AND WASTEWATER TREATMENT IN LATIN AMERICA--APPLIED TECHNOLOGY,
Universidade Central de Venezuela, Caracas. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5F.
W82-05425

SOME PERSPECTIVES IN THE MODELLING OF BIOLOGICAL TREATMENT OF WASTEWATERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
Water Science and Technology, Vol 14, No 1/2, p 227-240, 1982. 4 Fig, 44 Ref.

Descriptors: *Model studies, *Design criteria, *Research priorities, *Biological wastewater treatment, Computers, Activated sludge process, Trickling filters, Filters, Settleable solids, Sludge volume index, Optimization.

Modeling of biological wastewater treatment is reviewed, with emphasis on areas of dispute and needs for further research. Models of dispersed growth are extremely useful in understanding process fundamentals. However, more recent developments using a variable yield are improvements over the fixed yield models. Use of steady-state equations and evaluation of coefficients need to be improved. Fixed film reactor models have not reached the same stage of development as the dispersed growth models. Understanding of percolating filters lags behind high-rate filters. Processes involved are very complex and reactions are rate-limiting, except with very thin films. Settlement of flocculent suspensions does not lend itself to simple mathematical description. At present it is best to use models involving a sludge concentration factor which can be obtained from sludge volume index/sludge age relationship rather than a difficult-to-evaluate coefficient. Optimization models have reached a high degree of sophistication, and there is little point in further research in this field. Computers are often used in the process design stage which comprises 10-15% of the total required design time. There are many opportunities in extension of computer aid to structural design, preparation of bills of quantities, and preparation of design drawings. (Cassar-FRC)
W82-05430

THE EFFECTS OF TEMPERATURE ON THE BIOCHEMICAL REACTION RATES OF THE ACTIVATED SLUDGE PROCESS,
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Civil Engineering.
C. W. Randall, L. D. Benefield, and D. Buth.
Water Science and Technology, Vol 14, No 1/2, p 413-430, 1982. 11 Fig, 2 Tab, 17 Ref.

Descriptors: *Activated sludge process, *Temperature effects, *Kinetics, Nitrification, *Wastewater treatment, Oxygen requirements, Chemical reactions, Arrhenius equation, Aerobic digestion, Biological wastewater treatment, Microorganisms.

The effects of temperature change on biochemical reactions that occur in the activated sludge process were analyzed using experimental results and data from the literature. Results support the postulate that microbial population dynamics play an important role in temperature effects on biochemical reaction rates of mixed populations. Organic substrate stabilization follows the Arrhenius relationship over the temperature span 5-40C. Other biochemical reactions (production of cellular material, maintenance energy requirements, aerobic digestion, autooxidation of cellular material, and nitrification) generally follow the Arrhenius relationship from 5-10C. The Arrhenius relationship was valid for total oxygen consumption rates over the range 13-22C. The energy oxygenutilization coefficient was completely independent of temperature over the range 15-31.5C. Heterotrophs successfully metabolize substrate at lower temperatures than nitrifiers, and nitrite formers metabolize efficiently at lower temperatures than nitrate formers. (Cassar-FRC)
W82-05431

NITROGEN CONTROL AT THREE RELATED PLANTS,
Greeley and Hansen, Chicago, IL.
T. E. Wilson, E. D. Lukasik, and M. D. R. Riddell.
Water/Engineering and Management, Vol 128, No 12, p 43-44, 46, 50, 51. December, 1981. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Denitrification, *Nitrogen, *Sludge, Aeration, Biochemical oxygen demand, Settling basins, Retention capacity, Suspended solids, Effluent standards, *Chicago area.

Three large wastewater treatment plants near Chicago which incorporate full-scale nitrogen control processes are compared. Each has been operating in a nitrogen control mode for three years, with essentially the same liquid stream process flow. All three have excess flow retention basins. Plants at Waukegan and Gurnee are flexible in that they employ MID-Step nitrification, whereas the Clavey Road Plant has the advantage of greater aeration times and detention times. Studies of effluent quality show that performance of the Waukegan plant was less optimal than that of the Clavey Road or Gurnee plants. At the Waukegan plant design flow was exceeded during four months, and recycle streams caused excessively high loadings of biochemical oxygen demand and suspended solids. (Titus-FRC)
W82-05434

ENERGY CONSERVATION AND ALTERNATIVE ENERGY SOURCES IN WASTEWATER TREATMENT,
Anderson-Nichols and Co., Inc., Concord, NH.
E. L. Rushbrook, Jr., and D. A. Wilke.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2477-2483, October, 1980. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Wastewater treatment, *Energy, *Cost analysis, Project planning, Maintenance costs, Biological filters, Construction costs, Aerobic digestion, Solar energy, Design criteria, Wastewater facilities, Operating costs, Hillsborough, *New Hampshire.

With the passage of the Federal Water Pollution Control Act Amendments of 1972, significant changes were made in the requirements for water pollution control. These amendments coupled with increased pressure for energy conservation spurred the municipality of Hillsborough to investigate alternative treatment processes and energy sources for its wastewater facility. As a result of energy use studies, the use of rotating biological contactors with anaerobic digestion was chosen for innovative funding in November 1978. The project capital cost for the collection system and construction of the treatment plant was estimated at over $5.3 million in cost-effect analyses. In 1979, the town of Hillsborough voted to appropriate funds for the project, and the EPA declared the proposed alternative an innovative technology which was eligible for 85% funding. The Hillsborough project was placed on the 1981 Construction Grants Project List. (Geiger-FRC)
W82-05440

RELATIONSHIP BETWEEN ORGANIC LOADING, DISSOLVED OXYGEN CONCENTRATION AND SLUDGE SETTLEABILITY IN THE COMPLETELY-MIXED ACTIVATED SLUDGE PROCESS,
California Univ., Berkeley.
J. C. Palm, D. Jenkins, and D. S. Parker.

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Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2484-2506, October, 1980. 23 Fig, 3 Tab, 21 Ref.

Descriptors: *Organic loading, *Chemical oxygen demand, Process control, *Bulking sludge, *Dissolved oxygen, *Wastewater treatment, Activated sludge, Aeration, Biological wastewater treatment, Sludge conditioning, Microorganisms.

It is often difficult to draw well-defined relationships among aeration basin dissolved oxygen, chemical oxygen demand removal rate, and sludge bulking in wastewater treatment processes. To clarify this situation, experiments were carried out in continous flow, completely mixed activated sludge laboratory units operating at steady state on a settled domestic wastewater. A consistent relationship was found between the COD removal rate and the aeration basin DO level of the completely mixed activated sludge process. The data allows the establishment of COD removal rate/aeration basin DO level combinations that will prevent the development of large populations of filamentous organisms as well as the occurrence of bulking. An activated sludge that has bulked because of low aeration basin DO can be adjusted by raising the aeration basin DO to a value that prevents filamentous outgrowth from the floc. Scanning electron micrographs of activated sludge show the action of filamentous microorganisms in the bulking process. (Geiger-FRC)
W82-05441

SAFETY CONSIDERATIONS IN HANDLING ACTIVATED CARBON,
Environmental Services, Inc., Cleveland, OH.
G. E. Strudgeon, B. J. Lewis, W. W. Albury, and R. C. Clinger.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2516-2522, October, 1980. 4 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Safety, *Hazards, Accidents, Design criteria, Adsorbents, Dissolved oxygen, Wastewater facilities, Hydrogen sulfide.

Some of the hazards connected with the use of activated carbon for the treatment of wastewater are identified along with specific design and operational measures to minimize these hazards. Dust and dust explosions are a hazard in the carbon unloading area. Waste flows from activated carbon units that become low in dissolved oxygen may cuase hydrogen sulfide gases to be released by anaerobic organisms. Oxygen can also be adsorbed by wet carbon. Carbon may bridge and collapse, burying heavy objects or personnel. Activated carbon also tends to corrode equipment. Two case histories are presented in which low oxygen levels in the activated carbon solumns caused dangerous and even fatal accidents. A third case study showed that harmful off-gases could be released from a carbon regeneration furnace. It was suggested that the atmosphere inside of the vessel be checked, better ventilation installed, and probes be used to check carbon bridging to alleviate some of the hazards in an activated carbon facility. (Geiger-FRC)
W82-05442

INDUSTRIAL WASTE PRETREATMENT AND EPA CADMIUM LIMITATIONS,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5E.
W82-05443

START-UP PROBLEMS OF SLUDGE DEWATERING FACILITY,
Los Angeles County Sanitation Districts, CA.
B. E. Hansen, W. E. Garrison, and D. L. Smith.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2558-2570, October, 1980. 12 Fig, 3 Tab, 3 Ref.

Descriptors: *Design criteria, *Dewatering, *Scaling, *Foaming, *Wastewater facilities, Sludge conditioning, Sludge thickening, Wastewater treatment, Sludge digestion, Chemical treatment, *Sludge drying.

Problems in the start-up of the Joint Water Pollution Control Plant of the County of Los Angeles are described. Substantial changes in the digested sludge characteristics from 1970 to 1978 resulted in a finer, more dilute sludge. Scaling and foaming were also a problem. To control the scaling problem, work on a sulfuric acid addition project to control the pH of the feed sludge was undertaken. Foaming was partially corrected by feeding the digested sludge directly to the basket centrifuges. Since particles of the digested sludge solids played an important part in the sludge dilution, a return to a 3% sludge feed concentration and coarser particle size distribution resulted in adequate performance. The automation of polymer feed rate and the use of chemical dewatering aids also helped to stabilize plant performance. (Geiger-FRC)
W82-05444

MECHANISMS AND METHODS FOR POLYMER CONDITIONING OF ACTIVATED SLUDGE,
Missouri Univ.-Columbia.
J. T. Novak, and B.-E. Haugan.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2571-2580, October, 1980. 13 Fig, 10 Ref.

Descriptors: *Activated sludge, *Flocculation, *Mixing, *Dewatering, *Polymers, Wastewater treatment, Sludge thickening, Sludge conditioning, Model studies, Filtration, *Sludge drying.

Studies were conducted to uncover the mechanisms by which cationic polymers improve the dewatering of activated sludge of wastewater treatment plants. The effects of polymer dosing and mixing on sludge dewatering and floc stability were evaluated by a proposed floc surface model. The amount of polymer required was found to be dependent upon the mixing speed, mixing time, and sludge solids concentration. Tests with a pilot filter press confirmed the model predictions for filter performance. The optimal dose of polymer needed for filter press operation can be estimated by using the European recommended 'standard stirring device' which provides a mixing speed of 1,000 revolutions/min. Polymer additions to the sludge should be conducted at an energy input level similar to that in the standard stirrer. Undermixing could result in a sludge cake with lowered solids content while wasting expensive synthetic polymers. (Geiger-FRC)
W82-05445

COMPARATIVE DISINFECTION BY BROMINE CHLORIDE AND CHLORINE OF VIRUSES AND BACTERIA IN WASTEWATER,
Baylor Coll. of Medicine, Houston, TX.
B. H. Keswick, R. S. Fujioka, P. C. Loh, and N. C. Burbank.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2581-2588, October, 1980. 5 Tab, 21 Ref.

Descriptors: *Disinfection, *Bromine, *Chlorine, *Coliforms, *Enteroviruses, *Wastewater treatment, Halogens, Residual chlorine, Chlorides, Bacteria, Enteric bacteria, Viruses.

The efficiency and feasibility of using BrCl in place of Cl in the disinfection of human enteric viruses and indicator bacteria usually present in wastewater effluent was evaluated under field operating conditions. BrCl or Cl solutions were automatically and simultaneously injected into model contact chambers with activated sludge effluent flowing through them at a rate of 15.1 l/min with a contact time of 15 to 30 min. BrCl was found to be a more effective disinfectant than Cl for several human enteric viruses as well as for some naturally occurring coliform indicator bacteria. Whereas Cl was more effective in disinfecting human enteric viruses than coliform bacteria, BrCl was found to be equally effective against both types of pathogens. BrCl required a shorter contact time for efficacy than Cl, but the resulting residual BrCl was unstable compared with the stable residuals formed by Cl. These findings indicate that BrCl is a better disinfectant than Cl for use in the treatment of wastewater. (Geiger-FRC)
W82-05446

SULPHIDE CONTROL IN RISING MAINS,
Severn-Trent Water Authority (England).
I. W. Griffiths.
Water Pollution Control, Vol 80, No 5, p 644-647, 1981. 1 Tab.

Descriptors: *Sulfides, *Water mains, Water transport, Septic wastewater, Sewers, Rural areas, Sodium compounds, Nitrogen compounds, Iron compounds, Cost analysis.

Three separate rural sewerage systems in the Upper Severn Division of the Severn-Trent Water Authority, Great Britain, experienced severe difficulties as a result of sulfide produced from septic sewages. Several chemical treatments designed to prevent the production of sulfide were investigated in the laboratory and at operational levels. Treatments investigated included hydrogen peroxide, sodium nitrate, ferric nitrate, and a solution of ferric sulfate spiked with a little nitric acid. A solution of ferric sulfate and nitric acid, with a strength equivalent to 42,000 milligrams per liter nitrate nitrogen and 125,000 milligrams per liter ferric iron, was found to be the most cost effective of the treatments evaluated for overcoming the septicity problems in sewer mains. Although attempts to correlate chemical dosing levels with flow, retention period, and sulfide concentrations in the sewers were unsuccessful, a consistent relationship was found between total internal surface area of the main and the dose rate required per hour of pumping. Since the size of the dosing pump is critical to efficient treatment, it is necessary to calculate the dosage level requirements on a particular main prior to treatment. The costs of treatment vary with respect to the length and diameter of the rising main and with the frequency and duration of pumping. (Carroll-FRC)
W82-05465

CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND AS INDICATORS OF BIODEGRADABLE SUBSTRATE CONCENTRATION,
Technion - Israel Inst. of Tech., Haifa. Environmental Engineering Labs.
M. Green, G. Shelef, and R. Moraine.
Water Pollution Control, Vol 80, No 5, p 655-658, 1981. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Biological wastewater treatment, *Oxygen demand, *Substrates, Biodegradation, Chemical oxygen demand, Biological oxygen demand, Wastewater treatment.

The use of biological oxygen demand (BOD) as a measurement of organic substrate concentration in biological wastewater treatment processes was compared with the use of chemical oxygen demand (COD) for this purpose. This study also investigated the questions of whether BOD may underestimate substrate concentration and whether COD values may be used with certain modifications in kinetic models relating biomass growth rate to total substrate concentration. The 5-day biochemical oxygen demand test and the ultimate BOD test were both found to underestimate the true concentration of biodegradable substrate in wastewater and the incremental amount which is removed by biological activity. The COD test can be readily used to describe changes in the substrate concentration and to compute substrate removal rates and biomass yields. In order to use the COD test for kinetic models which involve the total substrate concentration rather than the incremental one, it is first necessary to overcome the problem caused by the nonbiodegradable fraction of the COD. This can be accomplished by estimating the nonbiodegradable fraction, which is fairly constant for a given type of sewage and under the typical range of activated sludge operating condtions. Laboratory experiments can contrive conditions which will result in a constant ratio of effluent COD to nonbiodegradable COD by maintaining the product of biomass concentration and residence time at a constant value. (Carroll-FRC)
W82-05466

A COMPARISON OF THE CARBONACEOUS OXYGEN DEMANDS OF A DOMESTIC AND INDUSTRIAL SEWAGE,
T. Stones.

Water Pollution Control, Vol 80, No 5, p 659-662, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Oxygen demand, *Wastewater oxidation, Biochemical oxygen demand, Chemical oxygen demand, Wastewater treatment, Wastewater analysis.

Sewage is characterized on the basis of its demand for oxygen. Since this demand is determined by the amount of oxidizable matter in the sewage,oxygen demand is designated as the sewage's strength. Arbitrary criteria which have been adopted as parameters for assessing the strength of sewage include the 5-day biochemical oxygen demand (BOD) and the permanganate value. However, these measures will provide truly comparative results only if the oxidation always occurs at the same rate, so that the measures always give the same constant proportion of the total carbonaceous oxygen demand. Experiments with industrial and domestic sewages showed that the proportions of the total carbonaceous oxygen demand represented by the 5-day BOD and by the permanganate value were not constant, but varied with the nature of the sewage. In addition, the two measures may give conflicting results. A low 5-day BOD may not necessarily represent a weak sewage, but rather one that contains a relatively high proportion of carbonaceous matter which is inert to biochemical oxidation. Similarly, a high permanganate value may not represent a strong sewage, but rather result from one that is rapidly oxidized by acid permanganate, giving an unrealistically inflated value for its strength. However, the ratio of the 5-day BOD of a sewage to its COD does provide a rational indication of its amenability to treatment. (Carroll-FRC)
W82-05467

THE PERFORMANCE OF AN OFF-SEWER STORM-SEWAGE TANK,
Secretary of State for Scotland, Edinburgh. Scottish Development Dept.
R. J. A. Henderson, W. McBain, and F. Pettigrew.
Water Pollution Control, Vol 80, No 5, p 582-599, 1981. 10 Fig, 6 Tab, 4 Ref.

Descriptors: *Combined sewer overflows, *Storage tanks, *Storm sewers, *Storm wastewater, Wastewater disposal, Wastewater management, Water pollution control, Performance evaluation.

In many areas, municipal sewage and storm water are discharged to a combined sewer system. When heavy rain results in system overloads, the normal practice is to relieve the drainage system through controlled spillages into a watercourse. The use of storage tanks to collect initial storm overflows, with further flow discharged over the tank outlet weir to the watercourse, is increasing. The Bannockburn sewer catchment in Scotland, which is served by both separate and combined drainage systems, uses an off-sewer storm-sewage tank overflow system for storm water management. The storm-sewage arrangement consists of a circular, 20 meter diameter storage tank with a peripheral overflow weir discharging to the Bannockburn watercourse. This paper describes research designed to quantify some of the benefits ascribed to the use of storage tanks at storm-sewage overflows. The pattern over time of the biochemical oxygen demand (BOD) and suspended solids concentration of the overflow sewage showed a high pollution intensity at the start of an overflow event, followed by a steady decrease in strength. Investigations showed that by the time the storage tank was filled, the strength of the inflow was well below the strength of the original inflow and also weaker than the partially-settled sewage being overflowed to the river. In this case, diversion of sewer overflow directly to the river when the tank was full provided the best management alternative. When limits on the concentration of the discharge are to be enforced, plotting of time against BOD and suspended solids concentrations will provide information on the point at which the strength of the overflow falls below the required limit. The storage tank must be large enough to collect the volume of overflow before this point. Several methods for determining this volume are discussed. (Carroll-FRC)
W82-05469

THE COLESHILL ADVANCED WASTE-WATER TREATMENT PLANT,
Water Research Centre, Marlow (England).
N. B. Banks, and A. J. Butwell.
Water Pollution Control, Vol 80, No 5, p 559-570, 1981. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater facilities, *Wastewater treatment, Physicochemical treatment, Pilot plants, Advanced wastewater treatment, England, Research facilities, Coleshill Experimental Plant.

The Coleshill Experimental Plant, formerly the Coleshill Advanced Waste-Water Treatment Plant, was built as a pilot plant for the investigation of the applicability of physicochemical methods of treatment to British sewages and as a proving ground for sewage-treatment projects generally. The plant and its antecedents are described. Experimental work conducted at the plant since partial operation began in 1975 has included study of chemically-aided sedimentation, including lime treatment, ferric sulfate, aluminum sulfate, phosphate removal, cost of chemicals, sludge production, and total costs; treatment in granular activated carbon columns, including downflow experiments and carbon capacity; and comparison of physicochemical treatment and activated sludge treatment. The pilot plant is now managed by the Water Research Centre. Several modifications are envisioned as part of this new role. New areas of research which will be addressed in the future are identified. (Carroll-FRC)
W82-05470

A COMPUTER-BASED CENTRALIZED CONTROL AND SUPERVISORY SYSTEM FOR THE DAVYHULME SEWAGE TREATMENT WORKS,
Kennedy and Donkin (England).
M. R. Windle, and T. E. Chappell.
Water Pollution Control, Vol 80, No 5, p 663-673, 1981. 3 Fig.

Descriptors: *Wastewater facilities, *Computers, *Automation, Wastewater treatment, Design criteria, Monitoring, Process control, Remote control, Telemetry, Performance evaluation, Planning, Davyhulme.

The Davyhulme sewage treatment works in Great Britain treats the sewage and industrial effluent from the Greater Manchester metropolitan area. Since the original Davyhulme plant was completed in 1894, major extensions have been made periodically. The works now includes two activated sludge plants, with a third activated sludge plant planned for the future. The control and instrumentation equipment for the plants is generally mounted individually on the plant or grouped on control panels local to the plant and staffed by plant attendants on a permanent or roving basis. The interrelated operation of the existing plant with the new inlet facilities added during 1980 and the need for integrated operation of the old and new facilities, together with the considerable amount of control and instrumentation equipment associated with the new inlet works, focused attention on the need for centralized control and supervision of the plant. A review of the feasibility and cost-effectiveness of central control options indicated that the older activated sludge plant should be provided with centralized plant monitoring facilities, but that operation of the plant should be carried out by local plant operators under the control of the operator in the central control room, while the newer activated sludge plant should be provided with central remote control and supervision. An evaluation of three centralized control and supervisory systems concluded that a computer-based telemetry system was most appropriate in view of planned expansions. This system provides telemetry outstations for the transmission of control from and indication signals to a central master station and computer, direct digital control, software-based sequence control, centralized fire alarm annunciators and communications, and provisions for emergency operation. Specific design features and evaluation criteria are discussed. (Carroll-FRC)
W82-05472

PRODUCTION AND CONDITIONING OF SLUDGES FROM A HIGH-RATE BIOLOGICAL FILTER,
Commonwealth Scientific and Industrial Research Organization, Rockhampton (Australia). Meat Research Lab.
S. P. Moodie, and B. V. Kavanagh.
Water Pollution Control, Vol 80, No 5, p 674-681, 1981. 6 Fig, 3 Tab, 19 Ref.

Descriptors: *Biological filters, *Sludge conditioning, *Industrial wastewater, Food-processing wastes, Wastewater treatment, Clarification, Sedimentation, Chemical oxygen demand, Dewatering.

The treatment of meat processing wastewaters with pilot-scale biological filters has been the subject of several studies. However, most of these studies have investigated the effects of various operating variables on the removal of chemical oxygen demand (COD) from the wastewater. Little attention has been given to clarification of the effluent from these filters or to the disposal of the resulting sludges. This study of the use of pilot-scale high-rate biological filters for the treatment of meat processing wastewaters examined the settling characteristics of the effluent from the filter, the rate of sludge production, and the dewatering and chemical conditioning of the effluent from the filter. The emphasis of the study was on the development of information for design purposes. The study found that effluents from high-rate biological filters typically contain high levels of suspended solids and COD. As a result, clarification of these effluents is a significant factor in determining the overall degree of COD removal. Settling tests showed that meat processing wastewater requires a clarifier surface overflow rate of about 50 cubic meters per square meter per day to achieve removal of between 80 and 95% of settleable solids. The amount of sludge produced was found to be independent of the hydraulic rate and to have a mean value of about 0.35 kg dry solids per kilogram COD removed. Measurements of the specific resistance to filtration of the biological filter sludge indicated that chemical conditioning of the sludges would be necessary to facilitate dewatering by such devices as rotary vacuum filters or filter presses. Commercially available cationic polyelectrolytes and inorganic coagulants such as ferric chloride and alum were shown to be effective conditioning agents. (Carroll-FRC)
W82-05473

ORGANIC GROUPS AND MOLECULAR WEIGHT DISTRIBUTION IN TERTIARY EFFLUENTS AND RENOVATED WATERS,
Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
J. Manka, and M. Rebhun.
Water Research, Vol 16, No 4, p 399-403, April, 1982. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Humic acids, *Tertiary wastewater treatment, *Advanced wastewater treatment, *Organic compounds, *Ultrafiltration, *Clarified wastewater, Separation techniques, Organic matter, Biological wastewater treatment, Chemical treatment, Clarification, Wastewater treatment, Lime, Chemical oxygen demand.

The molecular weight (MW) distribution and group composition of soluble organics in effluents from successive biological and chemical treatment stages were studied in efforts to follow their removal during advanced wastewater treatment processes. Molecular weight distributions were determined by ultrafiltration of effluent samples collected over a period of almost 2 years from the oxidation pond, lime clarifier, and after-lime polishing pond at the first-stage treatment plant of the Dan region Sewage Reclamation Plant at Tel-Aviv. The effluent contained relatively high COD and nitrogen levels. The effluents from the lime clarifier and after lime polishing pond were low in suspended solids and BOD and very low in phosphate. Humic substances were the most prevalent organic group in the oxidation pond samples, followed by proteins. The removal of 70% of the humic acid substances occurred in the lime clarifier. In the secondary effluents, about 61% of the

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organics are included in the highest MW fraction. Maximum removals are obtained from the two highest MW fractions (72 and 65% respectively) in the advanced treatment. A correlation was noted between the emergence of an unidentifiable fraction after lime treatment and an increase in the lowest MW fraction in terms of absolute COD units. (Geiger-FRC)
W82-05480

SELECTED ORGANIC PESTICIDES, BEHAVIOR AND REMOVAL FROM DOMESTIC WASTEWATER BY CHEMICAL AND PHYSICAL PROCESSES,
North Texas State Univ., Denton. Inst. of Applied Sciences.
F. Y. Saleh, G. F. Lee, and H. W. Wolf.
Water Research, Vol 16, No 4, p 479-488, April, 1982. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Biological wastewater treatment, *Chemical coagulation, *Physicochemical treatment, *Organic pesticides, *Herbicides, *Halogenated pesticides, Domestic wastes, Wastewater treatment, Chemical treatment, Organic compounds, Separation techniques, Organic wastes, Pesticides, Activated carbon, Filtration.

The removal of selected chlorinated hydrocarbon pesticides and chlorophenoxy herbicides from a domestic wastewater by different regimes of biological, chemical, and physical treatment processes was examined qualitatively and quantitatively. Qualitative characteristic profiles showed a limited number of refractory organic residues on the chromatograms of extracts from each of the treatment units. In the biologically treated wastewater, 13 compounds including DDT and its metabolites, aldrin, dieldrin, and 2,4-D alkyl esters and salts were detected at the parts per trillion level. Chemical coagulation with alum-lime or lime-ferric chloride yielded slight reductions in the organic residues detected on the chromatograms. Mutimedia filtration had no noticeable effect on the organic residues remaining in wastewater after biological or chemical treatment. Activated carbon columns offered maximum removal of refractory organic residues when used for less than one year. The use of several sequences of treatment processes on domestic wastewater provided a high quality effluent virtually free of detectable organic residues. (Geiger-FRC)
W82-05481

INVESTIGATIONS OF NATURAL HUNGARIAN ZEOLITE FOR AMMONIA REMOVAL,
Veszpremi Vegyipari Egyetem (Hungary). Inst. for Analytical Chemistry.
J. Hlavay, G. Vigh, V. Olaszi, and J. Inczedy.
Water Research, Vol 16, No 4, p 417-420, April, 1982. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Separation techniques, *Ammonia, *Ion exchange, *Zeolites, *Nitrogen removal, Wastewater treatment, Municipal wastewater, Particle size, Cations, Synthetic hydrology, Nitrogen, Denitrification, Ammonium compounds.

Natural zeolites containing clinoptilolite have ion exchange properties showing a great affinity and selectivity for ammonium ions. The use of zeolite formed columns from Tokaj Mountain in Hungary for the removal of ammonia from synthetic and municipal wastewaters was studied under laboratory conditions. Particle size of the clinoptilolites played an important part in column performance. Na-from clinoptilolite in the particle size range of 0.5-1.0 mm gave optimal ion exchange at 5-7 BV/hr. Approximately 4.50 milligrams of ammonia-N/gram of clinoptilolite ammonia breakthrough capacity was achieved using synthetic wastewater in a column with inside diameter of 0.5 cm and 92 cm in length. Ten to twenty BV (bed volumes) of regenerant were required to remove 98-99% of the ammonia with flow rates of 5-7 BV/hr during regeneration of the ion exchange bed. (Geiger-FRC)
W82-05482

CONTROL OF ACTIVATED SLUDGE FILAMENTOUS BULKING--IV. EFFECT OF SLUDGE REGENERATION,
Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
J. Chudoba, M. Dohanyos, and P. Grau.
Water Science and Technology, Vol 14, No 1/2, p 73-93, 1982. 9 Fig, 1 Tab, 37 Ref.

Descriptors: *Sludge volume index, *Activated sludge process, *Regeneration, *Accumulation, Oxidation, Filamentous microorganisms, Microorganisms, Population dynamics, Wastewater treatment.

The accumulation-regeneration theory of microorganisms selection in activated sludge was verified in the laboratory. This theory is based on the observation that activated sludge organisms accululate and store soluble substrate prior to replication. This quantity of accumulated substrate is the accumulation capacity. It is assumed that the predominant microorganisms in a mixed culture are those with the highest accumulation capacity and rates. A sufficient regeneration period, which allows time for oxidation of the accumolated substrate, is necessary for optimum operation. An accululation-regeneration model is given. The two key parameters are the quantity of substrate removed which should be oxidized during the regeneration period and the average heterotrophic respiration rate in the whole system. The regeneration period is defined as the total period of activated sludge aeration in one accululation-regeneration cycle. Sludge volume index decreased with increases in the proportion of substrate oxidized and was < 200 ml per g only if more than 50% of the substrate was oxidized. Methods of reducing sludge bulking are illustrated in diagrams. (Cassar-FRC)
W82-05491

PROTEIN RECOVERY FROM DAIRY INDUSTRY WASTES WITH AEROBIC BIOFILTRATION,
Victoria Univ. of Manchester (England). Pollution Research Unit.
A. D. Wheatley, R. I. Mitra, and H. A. Hawkes.
Journal of Chemical Technology and Biotechnology, Vol 32, No 1, p 203-212, January, 1982. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Dairy industry, *Proteins, *Fungi, Wastewater treatment, Biofiltration, Filtration, Fusarium, Geotrichum, Aerobic conditions, Food-processing wastes.

The feasibility of recovering single cell protein on dairy industry wastes was studied. Field observations showed that wastes from five food or pharmaceutical plants (low pH and > 2.5 kg BOD loading per day) produced a predominantly fungal biomass. The most common species were Geotrichum and Fusarium. A detailed study of dairy wastes (butter, cream, milk bottling, cheese, yogurt, dried milk, and combinations of these) showed variations in species with type of waste and organic loading. In batch cultures Fusarium and Geotrichum grew within a pH range of 2-10, but the 5-8 range was optimal. Geotrichum grew between 7 and 35 C (optimum 28-31 C) and Fusarium grew between 12 and 36 C (optimum 28-30 C). Continuous cultures on horizontal fixed films produced 100 and 75 g per sq m of surface (dry weight) of Geotrichum and Fusarium, respectively. Biomass and growth rate were dependent on applied organic loading. A pilot plant for treating cheese, butter, and cream production wastes was run at pH 4-5 and 5-10 kg BOD per day per cu m. BOD removal was 30-50% and biomass production 0.1-0.5 kg per day (dry weight). The amino acid content was similar to that of other single cell proteins. The biomass was white and had a slight odor of stale milk. (Cassar-FRC)
W82-05497

INFLUENCE OF HIGH PARTIAL PRESSURE OF CARBON DIOXIDE AND/OR OXYGEN ON NITRIFICATION,
Water Research Center Stevenage (England).
G. L. Jones, and A. R. Paskins.
Journal of Chemical Technology and Biotechnology, Vol 32, No 1, p 213-223, January, 1982. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Nitrification, *Oxygen, *Carbon dioxide, *Bacteria, Wastewater treatment, Growth rates.

The high concentrations of carbon dioxide and oxygen in the mixed liquor of intensive wastewater treatment processes such as the oxygen activated sludge process. the Deep Shaft process, and the fluidized bed reactor inhibit nitrification. Mixed cultures of nitrifiers were exposed to different proportions of C02 and 0 while being maintained at constant pH (7.8) and temperature (20 C). The specific growth rate of the nitrifying bacteria was independent of C02 concentration to 20% produced acidic conditions. Addition of NaOH to maintain constant pH caused a buildup of Na ions to 26 g per cu dm after 10 days and a 50% reduction in dry weight of the culture. Nitrification was only 40-50% at pH 7.4 and nearly zero at pH 6.8 and below, compared with 100% at pH 7.8. Nitrifying bacteria were initially inhibited by high partial pressures of 0 but appeared to acclimatize and retain the ammonia-oxidizing ability even after exposure to lower partial pressures for several generations and subsequent reexposure to higher pressures. (Cassar-FRC)
W82-05498

THE INFLUENCE OF NITROGEN ON PHOSPHORUS REMOVAL IN ACTIVATED SLUDGE PLANTS,
Meiring (P. G. J.) and Partners (South Africa).
J. L. Barnard.
Water Science and Technology, Vol 14, No 1/2, p 31-45, 1982. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Activated sludge process, *Nitrogen removal, *Phoshorus removal, Wastewater treatment, Nitrates, Nitrification, Denitrification, Anaerobic conditions, Phoredox process, Dissolved oxygen, Oxygen, Organic carbon, Sedimentation, Sludge.

Nitrates can interfere with phosphorus removal in activated sludge plants under some conditions. Nitrates serve as alternate sources of oxygen, preventing anaerobic conditions. Nitrification should be avoided and nitrate concentrations kept low. When nitrification is required, the nitrates must be reduced to low levels by internal denitrification. Sufficient carbon (ratios of COD: TKN of 10:1 or greater) for nitrate removal and anaerobic conditions in a specific zone of the plant ensures good phosphate removal. Several practical meaures may be considered to achieve N and P removal at lower COD:TKN ratios: (1) partial bypass of the primary sedimentation process, (2) sludge return at times of low load, (3) avoidance of aeration or turbulence in the anaerobic zone, (4) prethickening of sludge to prevent return of liquid from the anaerobic phase, (5) adjustment of the zones' arrangement to suit the nature of the organic compounds in the sewage, (6) control of dissolved oxygen in the aeration basin to minimize return of dissolved oxygen to the anoxic basin, (7) prevention of aeration of phosphorus-containing wasted sludge, (8) a retention time of 2.5 hours in the anaerobic basin, and (9) supplementary chemical additions if cost-effective. (Cassar-FRC)
W82-05504

DEVELOPMENTS IN WASTEWATER HANDLING AT POWER PLANTS,
R. C. Rittenhouse.
Power Engineering, Vol 86, No 3, p 34-42, March, 1982. 2 Fig, 6 Tab.

Descriptors: *Powerplants, *Zero discharge, Wastewater treatment, Industrial wastewater, Waste treatment, Design criteria, Cooling towers, Evaporation, Water reuse, Thermal pollution, Monitoring.

Many options for wastewater handling systems at powerplants are available. The experiences at several zero discharge facilities, the efforts to reduce cooling tower blowdown, the problems of thermal

discharges, and recommendations for monitoring groundwater at powerplant disposal sites are presented. Retrofitting the operating Martin Drake Power Station, Colorado Springs, to produce zero discharge is described in detail. Designing a zero discharge system for a new plant is not limited by existing equipment capabilities. The wastewater system is so important that it should receive the same priority as the power block in the design stage. Zero discharge is not economically or environmentally feasible for every geographic area, and it must not be promoted as a cure-all or national goal for all powerplants. Other equipment can limit, rather than totally eliminate, waste discharges by side-stream softening, reuse of some streams as process water, and wet and dry scrubbers. Commercial methods available for reducing cooling tower blowdown are vapor-compression-evaporation, chemical softening in makeup and side-stream treatment modes, electrodialysis, and reverse osmosis. Some experimental methods are wet/dry cooling, indirect freeze concentration, foam-enhanced evaporation, and the magma cooling tower. There is much controversy in handling of thermal discharges, which in many cases have little or no adverse environmental effects, but must nevertheless be treated with expensive equipment. Proper handling of coal pile runoff, fly ash, bottom ash, and flue desulfurization wastes to prevent groundwater contamination are still being debated. (Cassar-FRC)
W82-05517

FACTORS TO BE CONSIDERED IN DISPOSING DOMESTIC WASTE ON PROBLEM SITES AND APPRAISAL OF WATER QUALITY IN A PIEDMONT SETTING,
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
G. A. Gayle, G. B. Reddy, M. R. Reddy, S. M. Ross, and S. J. Dunn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232000, Price codes: A05 in paper copy, A01 in microfiche. Report No 160, June, 1981. 79 p, 20 Fig, 16 Tab, 28 Ref. OWRT A-105-NC(1), 14-34-0001-9035.

Descriptors: *Domestic wastes, *Water quality, *Waste disposal, *Impervious soils, *Septic tanks, Wastes, Wastewater treatment, Soils, Slopes, On-site tests, Flow rates, Flow characteristics, Water table rise, Septic wastewater, Wastewater absorption, Field capacity.

A method is proposed for sizing septic tank absorption fields by examining the effect of domestic waste on water quality and water table elevations. The necessity for thorough on-site evaluation of sloping impermeable soils such as those encountered in the study area is emphasized. On-site determinations were made on hydraulic conductivity, percolation, infiltration rates, and water quality. To characterize flow, it was necessary to ascertain the relation between design-flow rate and the water table rise in terms of soils and site parameters. A published method was used to determine the uniform flow depth on sloping soils which allowed the determination of the flow rate and on estimation of trench length to be made. This method showed good agreement with a standard method. Water quality studies suggested the principal ionic species in wells to be calcium, magnesium, sodium, and bicarbonate, and that most of the deep wells produce water from two different aquifers. In addition, most well water was found to be relatively hard, and nitrate and phosphorus were below EPA limits. However, the observed presence of fecal coliforms, apparently from adjacent septic systems, indicate a potential community health hazard. (Zielinski-MASIMA)
W82-05536

FIELD TEST EVALUATION RESEARCH AND DEVELOPMENT AND OPERATION AND MAINTENANCE OF REVERSE OSMOSIS SYSTEMS AND ELECTRODIALYSIS PILOT PLANTS AT ROSWELL TEST FACILITY.
For primary bibliographic entry see Field 3A.
W82-05555

FURTHER RESULTS ON THE PERFORMACE OF PRESENT-DAY OSMOTIC MEMBRANES IN VARIOUS OSMOTIC REGIONS,
InterTechnology/Solar Corp., Warrenton, VA.
For primary bibliographic entry see Field 3A.
W82-05660

EFFECTS OF SALTS ON ACTIVATED CARBON ADSORPTION OF FULVIC ACIDS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-05667

REMOVING TRIHALOMETHANE PRECURSORS BY PERMANGANATE OXIDATION AND MANGANESE DIOXIDE ADSORPTION,
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W82-05668

EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,
Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5F.
W82-05670

CONSIDERING SLUDGE PRODUCTION IN THE SELECTION OF COAGULANTS,
Montgomery (James M.), Inc., Reston, VA.
For primary bibliographic entry see Field 5F.
W82-05675

REACTIVITY OF HALOGENS WITH AQUEOUS MICROPOLLUTANTS: A MECHANISM FOR THE FORMATION OF TRIHALOMETHANES,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W82-05678

ANAEROBIC TREATMENT IN NOVEL CONTACT DIGESTER,
Duncan, Lagnese and Associates, Inc., Pittsburgh, PA.
J. A. Oleszkiwicz, and S. Koziarski.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 367-378, April, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Anaerobic conditions, *Wastewater treatment, Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Industrial wastes, Animal wastes, Barn wastes.

Various methods of anaerobic digestion are compared as applied to the treatment of dilute piggery wastewaters from an industrial scale piggery. The work encompassed batch tests, studies in anaerobic flow-through digesters without sludge recycle, studies in contact digesters with continuous sludge recycle, and studies in upflow anaerobic biofilters. Specific attention is given to the results of the continuous sludge recycle reactors study, which was designed as a combined unit encompassing both vigorous jet mixing with digester gas and quiescent sludge blanket upflow biofiltration-clarification. The studies explored the lower limits of hydraulic retention time (HRT) and the upper limits of organic loadings to the reactor. Gas production and methane content were studied and compared with gas yields from the anaerobic flow-through digesters. Raw piggery waste substrate was used as feed with chemical oxygen demand contents of 13-14 g/liter. The studies demonstrated the feasibility of obtaining methanogenic conditions at HRT as low as 0.5 d and corresponging organic load of 38 kg COD/cubic meter/day. Satisfactory secondary treatment was attained at HRT of 3.5 day and a load of 4 kg COD/cubic meter/day, yielding steady state chemical oxygen demand removals in excess of 85% and filtered effluent COD and BOD of 1,200 and 500 mg oxygen/liter, respectively. The biogas production at that loading is 3.15 cubuc meters/day. 75% of which was methane, which corresponds to 0.17 cubic meters/kg COD removed. (Baker-FRC)
W82-05681

ALGORITHM FOR OPTIMAL ACTIVATED SLUDGE OPERATION,
Lewis and Clark Law School, Portland, OR.
P. W. Hughey, D. D. Meredith, and A. C. Middleton.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 349-366, April, 1982. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Activated sludge processes, *Optimization, Systems analysis, Planning, Wastewater treatment, Sludge, Algorithms, Mathematical studies.

The objective of the present paper is to present a concise, readily usable, and efficient method for performing cost optimization in the operation of the activated sludge system by using realistic models for the unit processes. A method has been presented for determining the minimum cost operation of an activated sludge wastewater treatment plant for several time periods. This method was applied to a plant in Erie County, New York. The method uses a search technique for discrete valued variables to optimize a nonlinear cost function for the operation of an activated sludge process. To present the method and computational procedures, an example activated sludge system is presented. The operation of the activated sludge process was formulated as an optimization problem with nonlinear cost functions and realistic models for the unit processes. A complex method of constrained optimization for discrete-valued variables is also presented, and an example problem is solved for an existing plant. The complex method proved to be an efficient procedure for determining the optimal operation of an activated sludge wastewater treatment system. The procedure allows the use of nonlinear objective function, nonlinear noncontinuous constraints, and noncontinuous variables. Therefore, realistic process models and actual physical constraints can be used. The optimal operation procedures are obtained directly from the algorithm. The algorithm is developed so that the operator can use it with the same input data and data format that he is generally accustomed to using. Inflows for each period of operation need to be included in the analysis. However, the analysis may now be done for several different inflow sequences to determine operation sensitivity to inflows. (Baker-FRC)
W82-05682

SEWERS AND CITIES: FRANCE AND THE UNITED STATES COMPARED,
National School of Bridges and Roads, Paris (France).
G. Dupuy, and J. A. Tarr.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 327-338, April, 1982. 13 Ref.

Descriptors: *Wastewater treatment, *Sewer systems, France, United States, Reviews, Public policy, Urban wastewater, Political aspects, Governmental interrelations, Public health, Federal jurisdiction, Wastewater disposal, Storm runoff, Public investment.

This article attempts to compare the development of technological systems for the removal and disposal of human wastes in France and the United States. The areas addressed include the motivations driving technological innovation in the waste removal and disposal area, factors affecting system choice, the development and impacts of systems, and the relative roles of government, professional groups, and the public in influencing decisions. It was concluded that innovations in the water and wastewater areas were often made without fully understanding either the operation of systems being replaced or the possible impacts of the innovation. The primary anticipatory failures concerned the impacts of urban water systems and the

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disposal of the wastewater generated. Sewerage technology transferred the locus of pollution and hazards to public health from the immediate locale to downstream or down-lake cities. The resulting political and policy conflict over water quality illustrates the difficulty in changing a capital-intensive technology, implemented for beneficial reasons, when the negative impacts of the technology are felt by second parties. The existence of an in-place capital intensive technology and the policy of dealing with its negative impacts by retrofit discouraged attempts to deal with the original problem by alternative means. Due to the transport of pollutants over political boundaries, wastewater technology resulted in an upward shift of governmental regulatory power from local to the state and federal levels. General societal values such as a belief in progess and technological optimism were integral to the acceptance of the technology. (Baker-FRC)
W82-05684

ROTATING BIODISKS RECARBONATE ALKALINE WASTEWATER,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
C. I. Noss, R. D. Miller, and E. D. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 339-348, April, 1982. 5 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Nitrification, Alkalinity, Phosphorus, Lime, Rotating biological contactor, Microorganisms.

A study was performed on phosphorus removal by low-level lime (pH 9.5) precipitation in the primary clarifier, followed by biological recarbonation using the rotating biological contactor (RBC) process. The enhancement of nitrification by a chemically induced increase in pH was also demonstrated. The desired goal was to determine if the microbial populations attached to an RBC could function under the stress of elevated pH. Uniform flow rates were applied, thereby eliminating diurnal flow variations which could have affected recarbonation during full-scale treatments. The low level lime addition resulted in high alkalinity in the RBC at an optimum pH for nitrification. It also reduced the biochemical oxygen demand (BOD) loading to the RBC, which should increase the media surface area available for nitrifying organisms. Recarbonation and phosphorus removal were achieved at hydraulic loadings of 2.0,3.0, and 4.0 gal/day/square foot (0.08,0.12, and 0.16 cubic meters/square meter/day), but organic substrate removal was less efficient and nitrification was far less efficient at high loading. Splitting the wastewater influent among RBC stages did not significantly alter the performance of this system. (Baker-FRC)
W82-05685

PHARMACEUTICAL WASTE TREATMENT BY ANAEROBIC FILTER,
Camp, Dresser and McKee, Inc., New York.
E. F. Sachs, J. C. Jennett, and M. C. Rand.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 297-314, April, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Filter media, Pharmaceutical industry, Organic compounds, Industrial wastes, Anaerobic conditions, Adsorbents, Biochemical oxygen demand, Oxygen demand.

A study was designed to investigate the physical characteristics, chemical composition, and variations of wastewater from chemically synthesized pharmaceutical production, apply that waste to the anaerobic filter and determine its treatability. The anaerobic filter sucessfully treated the pharmaceutical waste at an influent chemical oxygen demand (COD) condentration of 2,000 mg/liter when operated at 35 degrees C utilizing a 36 hour hydraulic retention time, while producing constant COD removal efficiencies of 70-80% and biochemical oxygen demand (BOD) removals of 94%. The anaerobic filter exceeded the performance of the existing treatment scheme by 33% in terms of lb COD/1,000 cubic feet/day removed, and also greatly reduced the effluent color. The anaerobic filter could not withstand a threefold concentration increase as a shock loading as evidenced by 18% COD and 25% BOD reductions while feeding an influent COD concentration of 6000 mg/liter at a 36 hr hydraulic retention time. The anaerobic filter proved very useful as a pretreatment device for the treatment of chemically synthesized pharmaceutical waste. Low cellular synthesis rates and long solids retention times enable it to treat waste efficiently without the need for solids wasting. (Baker-FRC)
W82-05686

TREATABILITY OF TYPE A ZEOLITE IN WASTEWATER--PART I,
Procter and Gamble Co., Cincinnati, OH.
J. E. King, W. D. Hopping, and W. F. Holman.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2875-2886, December, 1980. 5 Fig, 5 Tab, 26 Ref.

Descriptors: *Zeolite, *Sewer systems, *Suspended solids, *Primary treatment, Detergents, Activated sludge process, Trickling filters, Wastewater treatment, Trace metals, Coagulation, Plumbing.

Type A Zeolite, a silica-alumina detergent builder with a particle size of 3-4 microns, did not accumulate in wastewater collection systems or adversely affect primary of secondary treatment processes. The sodium form of this agent is present in laundry formulations and the calcium form in wastewater. Testing was performed with concentrations of zeolite considerably higher than the 10 mg per liter expected under normal conditions. Examination of washing machine plumbing made of copper, iron, and polyvinyl chloride revealed only a very thin layer at some locations, apparently as a function of roughness, after a equivalent of 4-5 months of average home washing machine use. Sink traps contained no deposits ascribable to Zeolite Type A. Sewer lines in a village where 75 of 109 households used Zeolite Type A detergents had small amounts of the builder in the surface sediment layer. No long term accumulation or flow impairment was likely. In settling tests which modeled primary treatment, Type A Zeolite was removed with the other suspended solids. Model activated sludge and trickling filter processes removed 98% of the Zeolite; full-scale processes would probably be 80% effective. Both the smallest size fraction and the bulk material were removed to the extent of 97-98% by primary treatment and activated sludge-secondary clarification. Addition of ferric chloride, alum, or lime removed nearly 100% of the zeolite compared with 33-72% without chemical treatment. The activated sludge treatment of linear alkylbenzene sulfonate was not affected by addition of the Ca form zeolite up to 444 mg per liter. Effluent concentrations of trace metals were not adversely affected by the presence of the zeolite. (Cassar-FRC)
W82-05687

TREATABILITY OF TYPE A ZEOLITE IN WASTEWATER--PART II,
Procter and Gamble Co., Cincinnati, OH.
W. F. Holman, and W. D. Hopping.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2887-2905, December, 1980. 12 Fig, 11 Tab, 25 Ref.

Descriptors: *Zeolite, *Septic tanks, *Sludge conditioning, *Suspended solids, Settling velocity, Detergents, *Wastewater treatment, Percolation, Sludge thickening, Activated sludge, Anaerobic digestion, Dewatering.

The presence of the detergent builder, Type A Zeolite, in wastewater did not adversely affect sludge treatment processes or home wastewater treatment systems. The settling velocity of activated sludge was doubled at zeolite concentrations up to 20% of suspended solids (SS). The following processes were not adversely affected by zeolite: anaerobic digestion of sludge (up to 20% of SS); dewatering properties of unconditioned activated sludge (up to 53% of SS); dewatering properties of unconditioned anaerobic digester sludge (up to 20% of SS); and dewatering properties of chemically conditioned activated and anaerobic digester sludges (up to 20% of SS). The dosage of conditioning chemicals was not affected at zeolite concentrations up to 10% of SS. Laboratory septic tank units removed > 97% of the zeolite; field septic tanks, 81-88%. Process efficiencies, sludge volume, and soil percolation rate were not meaningfully affected. (Cassar-FRC)
W82-05688

EXAMINATION OF PROCESS PARAMETERS AFFECTING SLUDGE DEWATERING WITH A DIAPHRAGM FILTER PRESS,
K. A. Pietila, and P. J. Joubert.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1708-1716, December, 1981. 13 Fig, 5 Tab, 8 Ref.

Descriptors: *Sludge filters, *Dewatering, *Filtration, Sludge solids, Diaphragm filter press, *Wastewater treatment.

The diaphragm filter press for sludge dewatering is a two-step process--filtration and squeezing. It achieves the same % cake solids as the conventional presses but in only 15-25% of the time. Several process parameters were investigated in field tests at 11 treatment plants: cake solids, solids recovery, cake discharge characteristics, yield, feed solids, chemical dosage, filtration time, and squeeze time. As filtration time increased, cake solids decreased and sludge throughput increased. As squeeze time increased, cake solids increased and solids throughput decreased. As feed solids increased, cake solids and solids throughout increased with lower chemical requirements. As chemical dosage increased, cake solids and solids throughput increased. The diaphragm filter press has advantages over a conventional press: wide range of process flexibility and substantial reduction in chemical dosage. Proper cloth selection and cake discharge are necessary for maximum solids throughput. (Cassar-FRC)
W82-05695

MATERIALS BALANCE IN AERATED STATIC PILE COMPOSTING,
Science and Education Administration, Beltsville, MD.
L. J. Sikora, G. B. Willson, D. Colacicco, and J. F. Parr.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1702-1707, December, 1981. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Sludge cake, *Composting, *Aerobic conditions, Aeration, Decomposition, Sludge disposal, *Wastewater treatment.

Composting of wastewater sludge by the aerated static pile method was studied for a year to determine the material balance for design purposes. The pile base was 20 cu yd of used wood chips. Wood chip bulking agent (72 cu yd) was mixed with 30 tons of 22% solids sludge and covered with 64 cu yd of unscreened compost as a blanket. The dimensions of the pile were 45 ft x 18 ft x 8 ft. Aeration was provided for the 21-day cycle to produce temperatures averaging 80 C. Thirty tons of wastewater sludge filter cake produced 11.5 wet tons (27 cu yd) of screened compost. At each cycle about a third of the wood chips had to be replaced. The dry weight loss was 4.7 tons (11% of the initial dry weight) and the wet weight loss was 21 tons, equivalent to 5000 gal of water. (Cassar-FRC)
W82-05696

CRITERIA FOR ACHIEVING PATHOGEN DESTRUCTION DURING COMPOSTING,
Science and Education Administration, Beltsville, MD.
W. D. Burge, D. Colacicco, and W. N. Cramer.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1683-1690, December, 1981. 3 Fig, 1 Tab, 34 Ref.

Descriptors: *Composting, *Pathogens, *Coliphages, Fate of pollutants, Sludge, Viruses, Bacteria, Parasites, Coliforms, Enteric bacteria, Enteroviruses, Monitoring, Graphical methods, Wastewater treatment.

The f2 coliphage was a suitable indicator organism for determining the state of pathogen destruction in wastewater sludge compost piles. A literature search showed that this coliphage was more resistant to heat inactivation than any other enteric pathogen, except for some atypical mycobacteria. A family of curves was constructed relating time and temperature with logs of f2 inactivation. Direct determination of pathogens was not necessary. The degree of pathogen destruction was determined by monitoring compost pile temperatures at the coolest part of the pile, the toe or lower edge. To account for the temperature uncertainty inherent in composting sludge, a reduction of 15 logs of f2 concentration was suggested for complete pathogen destruction. (Cassar-FRC)
W82-05697

BIOFILTRATION DESIGN BASED ON VOLUMETRIC LOADING,
Research Inst. for Environmental Development, Wroclaw (Poland).
J. A. Oleszkiewicz.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2906-2913, December, 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Biofilters, *Organic loading, *Oxygen uptake, Activated sludge process, Trickling filters, Kinetics, Model studies, Mathematical models, *Wastewater treatment, Biological wastewater treatment, Industrial wastewater.

A model equating removal efficiency in biofilters to an exponential function of organic loading was shown to be applicable in cases where the Eckenfelder model gives insufficient correlation. The activated sludge and trickling filter models based on applied organic loading were shown to converge. The autooxidation coefficients were directly proportional to the biological activity of the slime and increased whenever slime showed increases in oxygen consumption. (Cassar-FRC)
W82-05698

SEPTAGE AND WASTEWATER TREATMENT IN THE ACTIVATED SLUDGE PROCESS,
Lowell Univ., MA.
B. A. Segall, and C. R. Ott.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2655-2665, November, 1980. 4 Fig, 8 Tab, 3 Ref.

Descriptors: *Municipal wastewater, *Design criteria, *Wastewater management, *Septic sludge, *Organic loading, Municipal wastes, Activated sludge, Clarifiers, Dissolved oxygen, Separation techniques, Wastewater treatment, Solid wastes.

Since septage is generally not accepted by municipal wastewater treatment plants in the Commonwealth of Massachusetts, this type of waste is discharged directly to land and surface waters. A septage monitoring program was carried out at the large Marlboro Easterly Wastewater Treatment Plant to determine feasible septage capacities for wastewater treatment facilities. Treatment cost and effluent quality were also examined. Results showed that a 2% addition of septage, on the average, doubles solids and organic loading on the treatment facility. Septage organic and solids content can be removed by a conventional activated sludge process. Septage did not markedly change oxygen utilization rates nor cause excessive short circuiting at feeding rates of 37% of the design flow rate and at wastewater flow within the design rate. Accumulation of anaerobic solids at the bottom can cause sludge upsets, especially during the summer months. In designing clarifiers for combined wastewater and septage solids removal, effluent quality, sludge removal, and surface skimming are critical. While septage seems to enhance settling and removal efficiency, particular attention should be paid to the skimming mechanism design. Fast removal of settled solids requires adequate pump and dewatering capacity. (Geiger-FRC)
W82-05699

LOAD FACTORS AND NON-DESTRUCTIVE TESTING OF CLAY PIPE,
National Clay Pipe Inst., Crystal Lake, IL.
For primary bibliographic entry see Field 8G.
W82-05700

EFFECTS OF CHEMICAL ADDITION ON THE PERFORMANCE OF SETTLING TANKS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. W. Heinke, A. J. Tay, and M. A. Qazi.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2946-2954, December, 1980. 5 Fig, 5 Tab, 17 Ref.

Descriptors: *Primary treatment, *Settling tanks, *Coagulation, *Wastewater treatment, Ferric chloride, Polymers, Design criteria, Suspended solids, Biological oxygen demand, Phosphorus removal.

Addition of ferric chloride and polymers to wastewater primary treatment tanks for the purpose of phosphorus removal produced secondary benefits. A 4-year study at three Ontario treatment plants revealed that chemical addition caused suspensions to settle more quickly. In design of new plants, smaller tanks may be used; for existing plants the settling tank capacity is substantially increased, avoiding or delaying expansion. BOD and suspended solids removal in the primary stage was enhanced. In some cases effluent was of high enough quality to discharge without further treatment. In others the load to the secondary system was greatly decreased. Costs for the chemicals were offset by decreases in capital costs for the primary and secondary treatment plants. However, more sludge was produced by the chemical addition. The following tentative design guidelines were proposed for primary horizontal-flow clarifiers treating domestic wastewater: design flow rate of 1.5 to 2.0 times the average daily flow, detention tiimes of 10-30 min with chemical addition and 20-45 min without, overflow rate of < 1.2 liters per sq m per sec under maximum flow conditions, velocity of < 8 ft per min under maximum flow conditions, and suspended solids removal efficiency of 70% with ferric chloride, 85% with ferric chloride plus polymer, and 40-50% with no chemical addition. (Cassar-FRC)
W82-05701

THE XIII OLYMPIC GAMES AND ENVIRONMENTAL QUALITY PERSPECTIVE,
D. A. Corliss, and K. Freiling.
Clearwaters, Vol 10, No 2, p 6-7, 9, June, 1980.

Descriptors: *Environmental effects, *Slope stabilization, *Wastewater treatment, Lake Placid, Olympic Games, New York, Soil stabilization, Sludge disposal, Erosion, Recreation wastes, *Waste disposal.

Waste disposal at Lake Placid, New York, during the Winter Olympic Games in 1980 had a minimal environmental impact. Sediment generated during construction caused stream load violations on numerous occasions. The problem was solved by using a properly designed and maintained sedimentation basin, and, on slopes, jute mesh, slope stabilization, and seeding. Portable toilet wastes were hauled to the Lake Placid treatment plant for treatment. Although a 10,000 gal holding tank was planned to control silver-containing photographic developing wastes from the Kodak film processing installation, it was not necessary because a silver recovery system was installed. Receiving streams were monitored continuously during the Olympic period. Flow in Lake Placid's treatment plant (2.5 mgd design capacity and 1.0 mgd normal winter flow) averaged 1.5-1.98 mgd during the peak period. Effluent COD did not exceed 120 mg per liter on any day. (Cassar-FRC)
W82-05703

LAND APPLICATION OF SECONDARY EFFLUENT AT LAKE GEORGE, NY,
D. B. Aulenbach, and N. L. Clesceri.
Clearwaters, Vol 10, No 2, p 16-21, June, 1980. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Land application, *Tertiary wastewater treatment, *Sand filters, Lake George, New York, Wastewater treatment, Filtration, Trickling filters, Recreation wastes, Infiltration, Water quality, Nutrients, Nitrates, Phosphates, Environmental effects.

Since 1939 secondary effluent from the resort community of Lake George, New York has been successfully treated without chlorination by application to natural delta sand by intermittent dosing using the rapid infiltration technique. The system consists of sedimentation, sludge digestion, trickling filter treatment, secondary sedimentation, and land application. At present the maximum daily summer flows approach 1.3 mgd, near the treatment plant design capacity of 1.75 mgd. Occasionally all the sand beds are full and effluent is applied to beds in an adjacent field. If both force main pumps are running simultaneously, the flow reaches 2.5 mgd. This creates turbulent flow in the primary settling tanks and increases the suspended solids load to the trickling filters. In spite of temperatures s low as -30 F and occasional ice cover, the sand beds function satiffactorily. Infiltration rates vary between 0.3 and 1 ft per day. Immediately after cleaning (scraping, discing, and releveling) infiltration rates of 2.5 ft per day are observed. Average annual application is 63% of infiltration capacity for a slow bed and 82% for a fast bed. During the extreme conditions of August 1976 (heavy rainfall at a time of peak sewage flow) 100% of capacity was reached. Since the water ultimately returns to Lake George via seepage into streams, water quality is monitored for nutrients and bacteria. Biodegradable matter, coliforms, and fecal streptococci are removed in the top of the sand. Viruses were not determined. The seepage water, of drinking water quality, contains 5-6 mg per liter more nitrate and 2 micrograms per liter more otheophosphate than background levels of the local groundwater. (Cassar-FRC)
W82-05704

POISONS IN THE HUDSON,
For primary bibliographic entry see Field 5G.
W82-05705

DIE-AWAY KINETICS OF AEROSOLIZED BACTERIA FROM SPRINKLER APPLICATION OF WASTEWATER,
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
B. Teltsch, H. I. Shuval, and J. Tadmor.
Applied and Environmental Microbiology, Vol 39, No 6, p 1191-1197, June, 1980. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Wastewater disposal, *Land disposal, *Bacteria, Mortality, Pathogens, Escherichia coli, Mathematical equations, Aeration, Aerosols, Public health, Wastewater treatment.

Increased emphasis on wastewater reuse and disposal by land treatment has emphasized the need for a means of predicting the concentration of aerosolized pathogenic microorganisms downwind from the wastewater spray or aeration site. Wastewater treatment processes involving aeration can lead to the formation of aerosols which contain concentrations of enteric microorganisms 100 times or more greater than that detected in the ambient liquid. This paper presents a methodology for estimating, under field conditions, the microbial die-away constant. This constant may be used in predicting the aerosolized pathogenic microorganism concentrations downwind from a spray or aeration site by means of modified atmospheric diffusion equations. Experiments conducted using Escherichia coli labeled with tritium demonstrated that there was a much slower rate of bacterial die-away in the morning than in the afternoon, when the meteorological conditions were more hostile to airborne bacteria. (Carroll-FRC)
W82-05706

LIBRARY U. of I. URBANA-CHAMPAIGN

SEWAGE PUMPING STATION SPLIT FOR MAINTENANCE,
Wilson and Co., Witchita, KS.
J. C. Dowell, and S. Wood.
Amerocan City and County, Vol 97, No 4, p 60-61, April, 1982. 1 Fig.

Descriptors: *Pumping plants, *Maintenance, Pumps, Wastewater treatment, Wichita, Kansas.

A dual-flow design permits half of the Wichita, Kansas, sewage pumping station to be shut down for maintenance and repairs while the other half continues to operate. The 160 mgd plant receives 35 mgd of bar-screened raw sewage during normal dry weather service. Each half of the pumping station contains a 17 ft wide, 22 ft long, 16 maximum depth wet well, four 24 inch sewage pumps (2 constant speed drive and 2 variable speed drive). The constant speed pumps are used only during wet weather flow. This arrangement is expected to handle growth in volume for the next 20 years. (Cassar-FRC)
W82-05719

'COMPUTERIZED' MEANS COST-EFFECTIVE FOR SEWAGE TREATMENT,
Thorn Creek Basin Sanitary District Water, Chicago Heights, IL.
R. A. Davis, and J. L. Daugherty.
American City and County, Vol 97, No 3, p 39-44, March, 1982.

Descriptors: *Computers, *Control systems, *Automation, *Wastewater treatment, Thorn Creek Basin Sanitary District, Chicago Heights, Illinois.

A computerized system was installed in the Thorn Creek Basin Sanitary District's advanced treatment plant in Chicago Heights, Illinois. The high speed digital processor is supported by printers, a remote station, and a color cathode ray tube display console. The computer logs all types of data as required and produces a 31-page monthly report. It supervises many operations including calculations, pumping, running blowers, chlorination, and flow control. A large variety of information is readily available for example, inputs and outputs, alarm occurrences, laboratory data, equipment status, and simulations. A computer system can save money through centalization of equipment, extended service life of equipment, manpower reduction, and energy conservation. (Cassar-FRC)
W82-05720

THE MECHANISM OF URANIUM BIOSORPTION BY RHIZOPUS ARRHIZUS,
McGill Univ., Montreal (Quebec). Dept. of Chemical Engineering.
M. Tsezos, and B. Volesky.
Biotechnology and Bioengineering, Vol 24, No 2, p 385-401, February, 1982. 10 Fig, 22 Ref.

Descriptors: *Uranium, *Biomass, Adsorption, Heavy metals, Wastewater treatment, Microorganisms, Industrial wastewater, Fungi, *Rhizopus.

This article presents an account of the work which led to the formation of a hypothesis on the mechanism of uranium biosorption by inactive Rhizopus arrhizus biomass. Experimental techniques used in the study included electron microscopy, x-ray energy dispersion analysis, and infrared spectroscopy, and supporting evidence was obtained for a biosorption mechanism consisting of at least three processes. Uranium coordination and adsorption in the cell wall chitin structure occurred simultaneously and rapidly, whereas precipitation of uranyl hydroxide within the chitin micro-crystalline cell wall structure took place at a lower rate. Interference of iron and zinc coions with uranium biosorption was indicated. Interference with any of these three processes can affect negatively the overall uranium biosorptive uptake. Such interference could involve the blocking of chitin amine nitrogen by other ions forming complexes or the increase in solubility of the adsorbate by changing the solution acidity. Uranium biosorption by inactive R. arrhizus is clearly a physicochemcial process with a considerable potential for technical applications, including industrial wastewater treatment. (Baker-FRC)
W82-05723

AN OVERVIEW OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ. Storm and Combined Sewer Section.
R. Field, H. Masters, and M. Singer.
Water Resources Bulletin, Vol 18, No 2, p 265-270, April, 1982. 3 Fig, 8 Ref.

Descriptors: *Storm water, *Paving, *Urban runoff, *Porous media, Asphaltic concrete, Concretes, Water management, Runoff volume, Design criteria, Recharge, Groundwater recharge, Drainage.

Porous pavement is a storm water management technique usable on parking lots and low traffic roadways to reduce runoff volume and pollution while increasing groundwater recharge. Cost reductions can result from elimination of curbs, drains, and small storm sewers. Porous asphalt pavements are a thin layer (0.75-1 inch) of open graded asphalt concrete mix overlying a deep base of large crushed stones. The surface coat has a coarse texture and a high void space ratio. This structure allows water to quickly enter the crushed stone layer, where it gradually drains to the subbase or in a lateral direction. Other surfaces include concrete lattice blocks and porous concrete. Each design situation is unique. However, a few general design suggestions can be mentioned. Most soils, with proper drainage, will be suitable. The base aggregate must be hard, durable, and angular. The surface aggregate should be 2 inches of 0.5 inch crushed stone. The porous asphalt concrete surface layer has a void volume of 16%. The asphalt is 50 to 100 penetration grade, according to climate, and 5.5 to 6% of total pavement weight. Current research programs are described. One concerns the long-term structural integrity of pavements under severe environmental conditions, and the other compares different types of porous pavement construction. (Cassar-FRC)
W82-05744

SEAWATER RO HEADS JAPAN'S WATER REUSE RESEARCH.
For primary bibliographic entry see Field 3A.
W82-05756

TRACKING SEASONAL LOAD VARIATIONS,
Worcester County Sanitary District, MD.
N. Connell.
Water/Engineering and Management, Vol 129, No 3, p 52, 54, March, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Seasonal variations, Water treatment facilities, Design criteria, Ocean City, Maryland, Tourism.

A serious problem in municipal wastewater treatment plants in resort areas is seasonal load variation. A primary treatment plant was designed for Worcester County Sanitary District at Ocean City, Maryland, to deal with this problem. New clarifiers with sludge withdrawal circuits for continuously seeding upstream aeration tanks are key elements in the design modifications. Primary treatment begins when the raw influent from the community enters a large grit chamber which channels the flow to a wet well and pump station for distribution to two inverted-siphon clarifiers. Automatic skimmers traverse the periphery of the clarifiers every 44 minutes, removing oil and scum to scum tanks. The underflow continues on to thickeners. In summer the thickener underflow is fed to a disintegrator. In winter the underflow is piped to two clarigesters - combination units promoting clarification and digestion. Off-season storage of sludge provides frequent breaks for inspection and maintenance of plant equipment. During the summer of 1976 the plant incinerated about 473,200 lb of dry solids. The oxygen waste-activated sludge process secondary treatment system was added to the Ocean City facility in March of 1981. System biomass is broken into three trains capable of handling a summer seasonal maximum of 12 mgd. In winter this drops to as low as 2 mgd. Thus process engineering efforts have successfully met the problem of seasonal waste load variation in Ocean City. A clean outfall is now discharged directly to the Atlantic Ocean and an inert biomass is trucked to a regional Maryland storage lagoon for injection to crop lands. (Baker-FRC)
W82-05787

RIGHT VELOCITY KEEPS THE SOLIDS UP,
Garland Wastewater Treatment Dept., TX.
B. Cook.
Water/Engineering and Management, Vol 129, No 3, p 49-50, March, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Water treatment facilities, Equalizing basins, Basins, Equalizing reservoirs, Balancing reservoirs, Construction, Design criteria.

The Duck Creek Wastewater Treatment Plant in Garland, Texas, features an oval equalization basin more than four times the length of a football field, surrounded by a sloping embankment resembling a stadium grandstand. The basin provides fully controlled flow of the wastewater to the plant, which incorporates both biological and chemical treatment. Flow control substantially reduces the quantities of chemicals used in the process and generates significant savings. About 25% of the wastewater is industrial. With a peak capacity of 30 mgd and a daily average flow of 15.5 mgd, the plant serves a population of about 100,000. Influent enters the equalization basin untreated. The basin acts as a surge facility to ensure controlled flow, as well as keeping the grit, sand and other solids suspended in the wastewater. It also introduces air to provide an adequate dissolved oxygen content. Wastewater flows from the basin through a grit chamber and bar screens, then into a pumping station where the flow is split into two streams. One stream is directed to a biological activated sludge treatment facility and the other through a chemical treatment plant incorporating four clarifiers with lime, ferric chloride and polymer injection for solids flocculation and settling. Wastewater is then piped to a recarbonation basin, where carbon dioxide lowers the high pH. It is then pumped through ultra-high rate mixed media filters and chlorinated for disinfection before discharge. Flow from the biological treatment facility joins the chemically treated stream before chlorination. (Baker-FRC)
W82-05788

SAVING WATER SCENICALLY,
Camp, Dresser, and McKee, Inc., Albuquerque, NM.
J. Burgh.
Water/Engineering and Management, Vol 129, No 3, p 46-47, March, 1982. 1 Fig.

Descriptors: *Water conservation, *Aesthetics, *Wastewater treatment, Design criteria, Construction, Wastewater facilities, Water treatment facilities, Wastewater renovation, Water reuse, Tourism.

An unusual wastewater reclamation system tailored to stringent site, recreational and aesthetic constraints was installed at the Bishop's Lodge resort in New Mexico. Designed to be an integral part of the resort, the system provides secondary treatment through a packaged extended-aeration plant. Effluent is either used for pasture irrigation or passed through pressure filtration and a pool and waterfall display which provides further aeration and exposure to sunlight. Water supply in this area of the country has always been limited, with an annual precipitation rate averaging only 13 inches. Tourists pass the treatment facility site, and therefore odors, noise and visual nuisances had to be strictly controlled. The potential for nitrate contamination of the valley's groundwater was an important consideration. An extremely short construction season had also to be considered. The arrangement as designed not only blends into the natural terrain, but also complements the riding and hiking trails. The secondary treatment unit is screened from view by means of earth mounds and plantings. Surrounding the pool system are foot

paths for strolling, and one of the principal pack trails crosses through a waterfall halfway up the hillside. Effluent is circulated through the pool system 8 to 12 times per day during the sunlight hours. Polished effluent is pumped to the lawn irrigation system. Similar systems were designed by the same architect for Disneyland, Disneyworld, and Busch Gardens. (Baker-FRC)
W82-05789

DEEP SHAFT,
J. Lock.
Water/Engineering and Management, Vol 129, No 3, p 57-58, 60, 62, March, 1982. 4 Fig.

Descriptors: *Wastewater treatment, *Design criteria, Water treatment facilities, London, England, Construction, Deep shaft process.

A Deep Shaft effluent treatment plant has been in operation since early 1978 at Marsh Farm Sewage Treatment Plant in Tilbury on the Thames, east of London, England. Four major benefits of deep shaft treatment are: primary settlement of the sewage is not needed, the sludge produced is able to be disposed without further treatment, real estate requirements are minimal, and environmental impact is easily controlled. One of the major requirements to make the process competitive with natural products was economy of scale; this was achieved by building a very large single stream plant. At its heart is the pressure cycle fermenter, designed for an annual output of 55,000 to 65,000 tons of dried product. Volume in the Deep Shaft process is dictated by the biodegradability of the wastewater to be treated rather than by oxygen transfer characteristics. The heart of the process is the deep shaft itself, with its head tank, from which nitrogen, oxygen and carbon dioxide bubbles rising from the shaft are released. Circulation of the liquid in the shaft is brought about by injecting air mainly or wholly into the downcomer. Since installation of the Shaft, the Anglian Water Authority has undertaken a series of studies to prove its ability to meet the design criteria and to determine the optimum process parameters for maximum and predictable performance. Start-up problems have included flow reversal, foaming, shaft ventilation, and blockages. (Baker-FRC)
W82-05793

RELIABILITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS IN FAIRFAX COUNTY, VIRGINIA,
Fairfax County Div. of Environmental Health, VA.
J. O. Bowman.
Journal of Environmental Health, Vol 44, No 5, p 249-252, March-April, 1982. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Wastewater disposal, *Septic tanks, Wastewater treatment, Septic wastewater, Environmental effects, *Virginia, Fairfax County.

In 1979 a study was made of on-site sewage disposal systems in the area of Fairfax County, Virginia, which had been installed between 1952 and 1978. The typical on-site system in this study consists of a septic tank, distribution box and soil absorption trenches. A typical system installed in 1955 served a three bedroom dwelling and consisted of 400 lineal feet of absorption trench. The typical system 20 years later served a four bedroom dwelling and consisted of a 1480 gallon septic tank with 480 lineal feet of absorption trenches. The increase in the size of the septic tank was due primarily to the popularity of garbage disposal devices and the requirement that all systems be designed for such devices. The study in 1979 showed that of the 1013 systems installed between 1952 and 1958, 96% were operational at the end of 20 years after installation and had not experienced any malfunctions. While the potential life of an on-site sewage disposal system is not known, the study revealed that of 62 systems installed in 1952, 97% have functioned satisfactorily for 27 years. Of the 110 systems which malfunctioned, the peak period for such occurrences was between the 11th and 18th year, with 47% occurring during this period. Seven systems were identified in which the malfunctions were attributed to soil clogging; the average period prior to this occurrence was 18.4 years. It was concluded that on-site sewage disposal systems for small wastewater flows offer a reliable method of disposal with minimal environmental impact. (Baker-FRC)
W82-05812

ROLE OF SURFACE ACTIVE MEDIA IN ANAEROBIC FILTERS,
Burk and Associates, Inc., New Orleans, LA.
K. A. Khan, M. T. Suidan, and W. H. Cross.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 269-285, April, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Anaerobic conditions, *Filter media, Activated carbon, Adsorbents, Coal, Wastewater treatment, Water treatment, Chemical oxygen demand, Oxygen demand.

The objectives of this study were to determine whether surface active granular activated carbon provides a better packing medium than nonporous anthracite coal for the anaerobic filter. The wastewaters used in the study included both synthetic wastewaters and a commercial aircraft paint-stripping wastewater. The organic content of the synthetic wastewaters included the readily degradable but poorly adsorbable glucose, the more biologically resistant, strongly adsorbable phenol, and combinations of the two organic nutrients. The glucose-bearing substrate was selected to minimize the adsorptive concentration polarization advantage of the activated carbon, while phenol was used to evaluate the role of substrate concentration polarization induced by the carbon surfaces. The response of the two filters under dynamic loading conditions of the phenol substrate was also evaluated. Throughout all phases of the study, the granular activated carbon packed filter out-performed the anthracite packed filter in terms of reduction of feed organic matter, methane production, and biomass retention. The granular activated carbon packed column resulted in a methane yield of 70.3% of the reduced dissolved chemical oxygen demand (DCOD), while only 38.5% of the reduced DCOD was converted to methane in the anthracite packed column. The DCOD and DOC conversion efficiencies obtained from the anthracite-packed column were 69 and 58%, respectively. An additional advantage of the carbon medium appears to be its biomass retention characteristics. (Baker-FRC)
W82-05816

HYDRAULIC REGIME AND ACTIVATED SLUDGE PERFORMANCE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
R. M. Sykes.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 286-296, April, 1982. 19 Ref.

Descriptors: *Activated sludge process, *Model studies, Biological oxygen demand, Chemical oxygen demand, Oxygen demand, Microorganisms, Sludge, Wastewater treatment.

An alternative to the standard bio-kinetic theory is presented to describe the activated sludge process. This new method identifies the effluent soluble organic matter (SOM) as a product synthesized and excreted by the microbes of the activated sludge. This model predicts that all aeration tanks treating a given wastewater will produce the same effluent SOM concentration if they contain the same total biomass and are operated at the same solids retention time (SRT). This alternative model also predicts that the effluent SOM concentration will be proportional to the influent organic matter concentration, that the apparent microbial decay rate will vary as different nutrients are considered, and that plots of the specific uptake rate versus the effluent SOM concentration will show a positive SOM intercept. All these predictions were supported by experiment. (Baker-FRC)
W82-05819

IMPROVEMENT OF SWIRL CONCENTRATOR,
Centre National de la Recherche Scientifique, Toulouse (France).
M. Alquier, D. Delmas, and M. Pellerej.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 379-390, April, 1982. 7 Fig, 6 Tab, 5 Ref.

Descriptors: *Combined sewer overflows, *Water treatment, Overflow, Sewer systems, Rainfall, Concentrator, Design criteria.

An analysis was made of a treatment device for pluvial water, as proposed by the American Public Works Association. The characterization of the convective-diffusive process is done by measuring the transit-time distribution of fluid and liquid particles. The study of similarity law done on two hydrualic models observes the critical velocity of solid particles as a similarity parameter. The device is called a swirl concentrator. The analysis showed that its efficiency greatly depends on a large eddy structure generated by an obstacle placed so as to obtain a usable hydraulic load-discharge characteristic. This large eddy structure is one of the most important phenomena in the efficiency obtained for the device. This has two effects on studies made on swirl concentrators. First the behavior is better characterized by the critical velocity of solid particles because of the resuspension of deposited solids. Second, it is possible to propose an obstacle configuration which increases the efficiency of the swirl concentrator. This configuration is on the basis of vertical bars put into the device. In swirl concentrators already built, the addition of such a pattern of bars improves the efficiency. (Baker-FRC)
W82-05821

INHIBITION OF NITRIFICATION BY ARSENIC, CHROMIUM, AND FLUORIDE,
College of Petroleum and Mineral, Dhahran (Saudi Arabia).
For primary bibliographic entry see Field 5C.
W82-05855

CHEMOMETRIC MODELING OF WASTEWATER TREATMENT PROCESSE,
Ford Motor Co., Dearborn, MI.
D. Schuetzle, J. R. Koskinen, and F. L. Horsfall, III.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 457-465, May, 1982. 5 Fig, 5 Tab, 33 Ref.

Descriptors: *Biological oxygen demand, *Statstical analysis, *Prediction, Wastewater treatment, Model studies, Chemometric methods, Nitrates, Phosphates, Suspended solids, Trace metals, Temperature effects.

Chemometric methods (pattern recognition) and multivariate analysis were used in modeling a complex lagoon system treating a wastewater containing petroleum oil, glycols, and esters. BOD was correlated with 19 other parameters, 6 describing input and 13 describing output. Data obtained from 166 days of operation were used to develop a model to predict BOD for the following 81 days. Accuracy of the prediction was an average of 87%. The most significant parameters that controlled prediction of BOD levels were minimum temperature, suspended solids, calcium, magnesium, nitrate, iron, and phosphate. Optimum values for some of these (in mg per liter) were phosphate, 12; Ca, 150; Mg, 3; and Fe, 0.3. There was no relationshp between influent pH and BOD reduction. (Cassar-FRC)
W82-05858

COMPARATIVE PERFORMANCE OF ROTATING BIOLOGICAL CONTRACTORS USING AIR AND PURE OXYGEN,
Missouri Univ., Rolla. Dept. of Civil Engineering.
J-C. Huang, and V. T. Bates.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2686-2703, November, 1980. 14 Fig, 1 Tab, 14 Ref.

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Descriptors: *Biological wastewater treatment, *Peformance evaluation, Oxygenation, Aeration, Dairy industry wastes, Industrial wastewaters, Oxidation, Organic matter, Biomass dynamics, Kinetics, chemical oxygen demand, Sludge, Settling velocity.

The objective of this study was to investigate the relative performances of three parallel rotating biological contractors in treating a synthetic milk waste by using air and pure oxygen under atmospheric or pressurized conditions. Performance parameters examined include acidity, dissolved oxygen, mixed liquor suspended solids, chemical oxygen demand reductions, sludge settleability, microbial nature, effluent suspended solids, ammonium-nitrogen, and nitrate-nitrogen. The thicknesses of the biofilms developed on the disk surface were increased by pure oxygen under pressure. This in turn improves the chemical oxygen demand reduction, provided that the waste strength is high and the biofilms do not bridge over the disk clearance. Use of pure oxygen also greatly improves the sludge settleability and reduces the filamentous growth. However, laboratory data appear to indicate that an excessively high concentration of dissolved oxygen has an inhibitory effect on biological nitrification. (Baker-FRC)
W82-05859

FILTERABILITY OF ACTIVATED SLUDGE IN RESPONSE TO GROWTH CONDITIONS,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, E. D. Smith, and R. Novak.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 444-456, May, 1982. 20 fig, 2 Tab, 30 Ref.

Descriptors: *Activated sludge process, *Filtration, *Nitrogen, Wastewater treatment, Sludge conditioning, Dewatering, Microorganisms, Wastewater composition, Filamentous bacteria, Bacteria.

Growth of activated sludge under severe nitrogen limitation of the influent wastewater produced sludge with poor dewatering properties. The filtering properties were poor in the presence of long-length filamentous organisms, dispersed and pin-point flocs, and extracellular biopolymers. However, short-length attached filaments were beneficial to floc formation and sludge filtration. Sludge with the best filtering properties in pilot plant tests was grown at a sludge age of 14.2 days and food/microorganism ratio of 0.35 for N-deficient sludge. N-rich sludges required higher chemical conditioner doses than N-deficient sludge. The presence of extracellular biopolymers, a natural thickening agent, also reduced the conditioner requirements. (Cassar-FRC)
W82-05860

MUNICIPAL POLLUTION ABATEMENT REPORT CARD: SIGNIFICANT PROGRESS,
Environmental Protection Agency, Washington, DC.
J. A. Chamblee.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 422-427, May, 1982. 2 Fig, 3 Tab.

Descriptors: *Municipal wastewater, *Capital costs, *Statistics, Wastewater treatment, Secondary wastewater treatment, Biological oxygen demand, Suspended solids, Grants, Clean Water Act, Economic aspects.

Municipal wastewater treatment statistics collected during a 1980 EPA survey show significant progress toward the nation's clean water goals. Compared with 1973, the total flow reaching treatment plants has increased 36% to 95,594 million cu m per day, BOD removal has increased 13% to 76.4%, solids removal has increased 11% to 79.6%, and dry sludge has increased 58% to 23,763 metric tons per day. The population served by treatment plants in 1980 was 156.7 million (70% of the total population), 8.5% more than in 1976. Those served by secondary treatment or better increased 25.3% since 1976 to 119.4 million (53% of population). Since 1976 the number of secondary plants has increased by 58.8% to 6852 and the number of plants that do not discharge, by 36.1%; to 1361. During 1973 to 1979 $20 billion in federal, state, and local funds and $6.3 billion in non-government funds were spent for capital improvements. By 1985 it is expected that flows reaching treatment plants will reach 28,000 mgd, an increase of 14%, and BOD removal and suspended solids removal efficiencies will have increased to 82.6% and 83.4%, respectively. (Cassar-FRC)
W82-05861

1980 NEEDS SURVEY: COMBINED SEWER SSITE STUDIES,
Water Resource Engineers, Gainesville, FL.
J. E. Scholl, and R. L. Wycoff.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 315-326, April, 1982. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Planning, Surveys, Data acquisition, Sewer systems, Economic aspects, Water treatment facilities, Costs, Environmental Protection Agency.

The Environmental Protection Agency is mandated to prepare a biennial estimate of the cost to achieve the goals of the Federal Water Pollution Control Act. Such an estimate requires conducting a survey. Sites for the survey are generally selected to provide a wide range of sizes of combined sewer systems and a representative distribution across the United States. The 1980 Needs Survey investigated 10 sites to develop transferable criteria, principles and relationships which could be applied nationwide to estimate the cost to construct publicly owned wet-weather pollution control facilities. The site studies were performed using a receiving water simulation program called the Continuous Stormwater Pollution Simulation System (CSPSS) and an economic optimization program called the Computer Optimized Stormwater Treatment (COST) program. For these 10 study sites it was found that three types of receiving water/urban area conditions existed with respect to dissolved oxygen concentrations. These were sites where no DO problem existed, sites where the problem could be solved with removal of various inputs, and sites where a DO problem remained. A direct link between the CSPSS receiving water analysis and COST program economic analysis was obtained. It was then possible to establish the combination of wet-weather pollution abatement alternatives which achieved the desired removal for the least total annual cost. (Baker-FRC)
W82-05862

5E. Ultimate Disposal Of Wastes

LAND DISPOSAL OF SLUDGE,
J. W. Cormack, F. J. Winter, and M. D. R. Riddell.
Public Works, Vol 113, No 2, p 42-44, 90, February, 1982. 3 Fig, 3 Tab.

Descriptors: *Land disposal, *Sludge disposal, *Landfills, Sanitary landfills, Waste dumps, Sludge, Wastewater treatment, Sludge utilization, Cost analysis, *Lake County, *Illinois.

The North Shore Sanitary District in Lake County, Illinois is located about 20 miles north of Chicago, adjacent to Lake Michigan. Wastewater is treated at three major advanced treatment plants, each providing biological nitrification, chemical precipitation of phosphorus, and effluent filtration. Raw and digested sludge are transported to Waukegan for dewatering and ultimate disposal in a landfill. A portion of the digested sludge is hauled by truck for use as soil conditioner and fertilizer during the growing season. Before selecting the site for the landfill, field tests were conducted to demonstrate the stability of the soil, and consultations were held with various members of government agencies and district staff so as to present detailed development and operating plans. Site preparations included demolition of existing minor buildings, installation of ten 30-foot deep groundwater monitoring wells, construction of a sludge delivery road, a 10,000 gallon leachate tank, a new well, and an access road, rerouting existing farm drainage tiles traversing the area, and constructing sod waterways to convey surface drainage through the project area to adjoining downstream land at existing runoff locations. The application of sludge on agricultural land is limited by the type of crop grown and the chemical constituents of the sludge, particularly heavy metals and nitrogen. Data suggest that nitrogen rather than heavy metal content is the limiting factor. Landspreading of a small amount of liquid digested sludge is significantly less costly than dewatering and landfilling the same sludge. The amount that can be landspread is limited by space and spreading equipment availabilities. (Baker-FRC)
W82-04757

IMPROVED THERMAL SLUDGE CONDITIONING BY TREATMENT WITH ACIDS AND BASES,
Union Carbide Corp., South Charleston, WV. Research and Development Dept.
G. M. Alsop, and R. A. Conway.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 146-152, February, 1982. 7 Fig, 6 Tab, 14 Ref.

Descriptors: *Sludge conditioning, *Dewatering, *Heat treatment, Acids, Bases, Pathogens, Coliforms, Bacteria, Zinc, Cadmium, Metals, Heavy metals, Filtration.

Temperature and reaction times for heat conditioning of sludge for dewatering were reduced by a base-heat-acid treatment. The laboratory-scale study used sludges with different characteristics, two petrochemical wastewater sludges and a domestic wastewater sludge. Although optimum conditions differed with the sludge properties, a typical conditioning process was treatment at pH 10 and 70 C for 60 seconds followed by reaction at initial pH of 3.5 and 90 C for 60 seconds. The first step extracts polymers from the cells, and the second modifies the cell surface and causes flocculation using the extracted polymers. This treatment produced only 50-60 mg per liter soluble organic carbon. Subsequent dewatering of the base-heat-acid conditioned sludge on a belt pressures (3-5 psig) produced 20-30% cake solids. The process reduced fecal coliforms from 2.3 million per 100 ml to zero. Odor in stored samples was almost negligible. Zn and Cd contents of sludge were reduced by 49% and 73%, respectively. Shear tests on the conditioned sludge showed that it was resistant to shearing and subject to less floc breakup during subsequent processing. Comparison with other sludge conditioning processes (FeCl-lime-filter press and polymer conditioning-basket centrifuge) showed similar capital costs and lower operating costs, $12 a ton vs. $18 and $19 a ton, respectively. (Cassar-FRC)
W82-04785

COMPARISON OF COLIPHAGE AAD BACTERIAL AEROSOLS AT A WASTEWATER SPRAY IRRIGATION SITE,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 3C.
W82-04830

AUTOMATIC CONTROL OF THE DISCHARGE OF RADIOACTIVE SUBSUBSTANCES FROM LIGHT WATER NUCLEAR POWER PLANTS OF THE PRESSURIZED WATER REACTOR TYPE INTO FLOWING STREAMS WITH SPECIAL REFERENCE TO THE UNTERWESER NUCLEAR POWER PLANT,
Wasserwirtschaftsamt Brake (Germany, F. R.).
H. Kunz.
Water Science and Technology, Vol 13, No 11-12, p 561-566, 1981. 3 Fig, 7 Ref,

Descriptors: *Monitoring, Data transmission, Remote sensing, *Water pollution prevention, *Radioactive wastes, Sensors, Data aquisition, *Nuclear powerplants, *Germany, Environmental protection, Water pollution control, Automation, Networks.

Nuclear power plants in the Federal Republic of Germany must apply for official permission to discharge radioactivity liquid wastes into receiving waters. In order to receive this permission the plant must be operated according to specific regulations. The Unterweser Nuclear Power Plant (KKU) is used as an example to demonstrate how the discharge of radioactive substances in a tidal river can be automatically monitored and controlled. The Nuclear Inspectorate is now making use of remote monitoring equipment to regulate the discharges of nuclear power stations and protect receiving waters of their surrounding environments. An automatic remote monitoring system is being installed in the KKU to check plant operation and levels of radioactive wastes in all possible receiving waters. The regulations laid down by the water authority extend from the receiving water to these measuring points. The KKU will be required to provide automatic data transmission to the water authority from all the designated measuring stations. (Geiger-FRC)
W82-04839

CASEIN WHEY WASTEWATER EFFECTS ON SOIL PERMEABILITY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 3C.
W82-04874

DISTRIBUTION OF PHOSPHORUS IN SOILS IRRIGATED WITH MUNICIPAL WASTEWATER EFFLUENT: A 5-YEAR STUDY,
Minnesota Agricultural Experiment Station, St. Paul.
For primary bibliographic entry see Field 3C.
W82-04881

DESIGNING WASTEWATER TREATMENT SYSTEMS TO SAVE ENERGY,
Edeco, Inc., Tulsa, OK.
For primary bibliographic entry see Field 5D.
W82-04906

LEACHATE COLLECTION DESIGN FOR CONTAINMENT LANDFILLS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, R. Poland, F. A. Rovers, and A. J. Crutcher.
Journal of the Environmental Engineering Division, Proceedings of the Amercan Society of Civil Engineers, Vol 108, No EE1, p 204-209, February, 1982. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Mathematical models, *Land disposal, *Landfills, *Leaching, *Waste management, Mathematical studies, Waste disposal, Water quality control, Model studies, Waste dumps, Leachates, Infiltration, Percolation, Groundwater movement, Subsurface drainage.

A simple methodology for use in designing leachate collection systems for the containment of wastes at disposal sites is presented. The methodology concentrates specifically on the engineering of drain spacing and groundwater mounding. A mathematical model is derived which describes leachate mounding over a sloping clay liner. The model, although implicit and nonlinear, converges rapidly. Parameter sensitivities can be readily manipulated for specific applications and to explore the need for new data input requirements into the model. The model was applied to the problem of designing a collection system for a landfill, where the concern is the impact on the groundwater mounding during leachate recycle, versus after the recycle is completed. The model will be useful in exploring the impacts of alternative designs for leachate collection systems. (Geiger-FRC)
W82-04996

CALORIFIC VALUE OF WASTEWATER PLANT SLUDGES,
Marquette Univ., Milwaukee, WI.
A. E. Zanoni, and D. L. Mueller.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 187-195, February, 1982. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Calorimetry, *Sludge utilization, *Chemical oxygen demand, *Volatile solids, Wastewater treatment, Mathematical studies, Sludge, Digested sludge, Primary sludge, Municipal wastewater, *Energy sources, Sludge disposal.

The energy usage of a wastewater treatment plant is an important consideration in its design and operation. The calorific values of various sludges generated during wastewater processing may be established by an oxygen bomb calorimeter. The use of this instrument in smaller plants is not a very common practice. To aid in calorific determinations, the calorific values of a variety of municipal waste water plant sludges are presented. A method for correlating the calorific value of a sludge sample to the COD value was developed. This procedure was sufficient for estimating the calorific value of most municipal wastewater plant sludges with a high degree of reliability. Calorific values of sludges were also correlated to the percent volatile solids value to compare the present results with those of other researchers. The COD correlation proved more accurate than the volatile residue technique. It was suggested that the COD determination is inherently a more sensitive measure of the material which accounts for the calorific content of the sludge. (Geiger-FRC)
W82-04997

WEAK CONTROLS FROM SEA TO SHINING SEA,
University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W82-05035

REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE,
Pennsylvania State Univ., Harrisburg. Dept. of Environmental Resources.
W. E. Sopper, and S. N. Kerr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102484, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-182, October 1981. 7 p, 4 Fig, 7 Tab. S-804511.

Descriptors: *Revegetation, *Strip mines, *Sludge disposal, *Land disposal, *Water pollution control, Groundwater pollution, Soil water, Trace metals, Bacteria, Coal mines, Municipal wastewater, Erosion control, Percolating water, Mine wastes, Impaired water use.

The lack of vegetative cover on old strip mine sites contributes to pollution from both soil erosion and acid mine drainage. The use of municipal sludge to revegetate mined land in an environmentally acceptable manner was demonstrated on several 4-ha plots in the anthracite and bituminous coal mining regions of Pennsylvania. Three sites representative of abandoned, barren bituminous and anthracite mines were treated with various types of municipal sludge at high and low application rates, and broadcast seeded with a mixture of grasses and legumes. A monitoring system was installed at each demonstration site to determine the effects of the sludge application on the chemical and bacteriological quality of groundwater and soil percolate water, chemical properties of the soil, and quality and growth of vegetative cover. Data collected during the 3-year period indicate that the sludge applications ameliorated the harsh site conditions and resulted in a quick vegetative cover that completely stabilized the demonstration site. Each site's vegetative cover has persisted and improved each year since its establishment. Although sludge applications increased some trace metal concentrations in the vegetation, all concentrations were below plant tolerance levels. Sludge applications have had no significant adverse effect on the chemical or bacteriologically quality of soil percolate or groundwater. (Moore-SRC)
W82-05065

PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC,
Louisville Gas and Electric Co., KY.
R. VanNess, A. Plumley, N. Mohn, C. Ullrich, and D. Hagerty.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105479, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-155, October 1981. 14 p, 8 Fig, 6 Tab, 10 Ref.

Descriptors: *Landfills, *Waste disposal, *Trace elements, *Groundwater pollution, *Leachates, Sludge, Land disposal, Soil contamination, Water pollution sources, Runoff, Permeability.

The most extensive commercial experience in flue gas desulfurization (FGD) to date has been with lime/limestone wet scrubbers. A major challenge associated with the commercial development of these systems is the disposal of large amounts of by-product sludge within the constraints of land and water quality regulations. Properly prepared landfill from FGD sludge/fly ash mixtures can prevent trace element contamination of underlying groundwater. Analyses of leachates from the series of landfill impoundments in this study show that trace elements on the Resource Conservation and Recovery Act (RCRA) list of contaminants were found in concentrations below those proposed to characterize hazardous or toxic wastes. Decreasing concentrations, with time, of trace contaminants were observed in both leachate and runoff samples obtained from the stabilized sludge mixtures. Small, synthetically lined, above-ground impoundments provided higher concentrations of trace contaminants than the subsurface impoundments since no attenuation by local soil was provided and vegetation that might minimize runoff was not established on these sites. Water samples from beneath larger subsurface impoundments indicated that the filtering action of soil aids in decreasing the concentration of contaminants reaching the ground water supply. Certain mixtures have undergone a fixation reaction, reducing the permeability and minimizing the release of moisture and contaminants to the surrounding soil. (Moore-SRC)
W82-05066

DISPOSING OF SEWAGE SLUDGE AT SEA,
S. H. Jenkins.
Marine Pollution Bulletin, Vol 13, No 2, p 37-39, February, 1982. 1 Tab.

Descriptors: *Sewage sludge, *Sludge disposal, *Ocean dumping, Environmental effects, *Regulations, Water pollution control, North Sea, *Germany.

A review of recent papers on sewage sludge disposal at sea shown that this problem is being handled by different methods according to national attitudes. The Federal Republic of Germany is planning to terminate all sludge disposal in the North Sea. The U.S. EPA's decision to prohibit sludge dumping in coastal waters has been challenged in light of conflicting evidence on its environmental effects. The United Kingdom disposes of sewage sludge at 13 ocean sites under annual licences granted by the Military of Agriculture, Fisheries, and Food. The effects of sludge dumping and pollution from rivers are carefully monitored by chemical analysis and bioassays to limit the undesirable elements to levels which can be absorbed by the sea without producing ecological damage. (Cassar-FRC)
W82-05127

IRRIGATION OF CALIFORNIAGRASS WITH DOMESTIC SEWAGE EFFLUENT: WATER AND NITROGEN BUDGETS AND CROP PRODUCTIVITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W82-05153

SLUDGE MANAGEMENT IN THE ROCKY MOUNTAIN STATE,

Library of the Urban Institute

Black and Veatch, Denver, CO.
M. J. Maxwell.
Water/Engineering and Management, Vol 128, No 12, pp 28-31, 56, 57, December, 1981. 4 Tab, 2 Fig.

Descriptors: *Sludge, *Sludge reconditioning, *Wastewater management, *Hydraulic capacity, Sludge drying, Aeration, Lagoon systems, Filtration, Aerobic digestion, Reclamation, Sludge cake, *Sludge disposal, Inventory, *Colorado, Sludge management.

A complete inventory of all municipal treatment plants in Colorado was carried out in 1980, to assess the status of wastewater sludge management in that state. More than half of the 318 municipal facilities are lagoon systems which do not routinely process sludge. Mechanical systems predominate in the Mountain Resort and Front Range areas, where land costs are high and population is dense. Most plants have ample reserve capacity. The most common sludge disposal method is land application. Less than 20 plants use mechanical thickening equipment. Most plants employ anaerobic digestion. About 70% of the plants which dewater sludge use drying beds. Three sludge stabilization processes, anaerobic digestion, aerobic digestion, and composting, are used in Colorado. (Titus-FRC)
W82-05165

PREDICTING FULL-SCALE BATCH THICKENER PERFORMANCE USING THE FROZEN-IMAGE CENTRIFUGE,
Water Research Centre, Stevenage (England).
C. F. Lockyear.
Effluent and Water Treatment Journal, Vol 21, No 12, p 560-563, December, 1981. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Sludge thickening, *Performance evaluation, *Centrifugation, Dewatering, Sludge drying, Prediction, Mathematical equations, *Wastewater treatment, *Sludge disposal.

Gravity thickening is a process commonly used to reduce the costs for treating and disposing of sewage sludges. The extreme variations in the characteristics of the sludge necessitate the use of laboratory characterization tests in operating and designing sludge treatment processes. The frozen-image centrifuge test is one such laboratory test. This technique uses a low speed centrifuge and involves observation of the change in the interface height between the sludge and the supernatant liquor. The experimental results are then used to calculate the change in solids concentration of the sludge with time and to predict the ultimate concentration achievable for a given height of sludge in a thickener. However, the technique does not provide information on the time needed to achieve these results. A new empirical equation is presented which links directly the time in a gravity thickener to achieve a particular concentration with the time in the frozen-image centrifuge to achieve the same concentration. This method can be used either to monitor the performance of full-scale thickeners or to design new units. (Carroll-FRC)
W82-05185

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 2 - ENVIRONMENTAL CONTROL TECHNOLOGY,
California Univ., Livermore. Lawrence Livermore Lab.
G. Armantrout, N. Crow, P. Leitner, C. R. Molenkamp, and F. Stephens.
Department of Energy Report DOE/EV-0092, July 1980. 133 p, 24 Fig, 18 Tab, 93 Ref. Morris, W., and Hill, J., Eds. W-7405-ENG-48.

Descriptors: *Geothermal power, *Geothermal resources, *Environmental control, *Brine disposal, *Injection, Subsidence, Cooling towers, Water quality, Waste disposal, Scaling, Drilling, Water treatment, *Imperial Valley, California.

Based on energy production scenarios and predicted environmental impact levels, environmental controls applicable to abatement of hydrogen sulfide emissions, cooling tower drift, noise, liquid and solid wastes, and induced subsidence and seismicity were assessed. Several currently available and emerging hydrogen sulfide abatement technologies are applicable to power systems contemplated for the Imperial Valley. The environmental impact of cooling tower drift will be closely tied to the quality of cooling water supplies. Although significant technological progress has been achieved in reducing drift emissions, the efficiency of drift eliminators may be rapidly degraded if low quality water supplies are used. Noise emission is not expected to be an important environmental issue. Spent geothermal brine constitutes the largest volume of waste generated in geothermal power plant operations. Other liquid wastes include: cooling tower blow-down fluid, accidentally discharged brine, and accidentally spilled process chemicals. These liquid wastes, for the most part, are expected to be disposed of by subsurface injection. Solid waste sources include: well drilling and wellbore cleanout debris, separated solids from spent brine and cooling water treatment operations, solids from hydrogen sulfide abatement, geothermal scale, and a variety of wastes from evaporation ponds and treatment facilities. Subsurface injection of fluids is the primary control for managing induced subsidence. Careful maintenance of injection pressure is expected to control induced seismicity. (Moore-SRC)
W82-05213

RESULTS OF DEEP-WELL INJECTION TESTING AT MULBERRY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05224

MICROBIAL ECOSYSTEMS RESPONSIBLE FOR ANAEROBIC DIGESTION AND COMPOSTING,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
M. S. Finstein, J. Cirello, D. J. Suler, M. L. Morris, and P. F. Strom.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2675-2685, November, 1980. 3 Tab, 47 Ref.

Descriptors: *Anaerobic digestion, *Composting, *Wastewater treatment, Sludge, *Waste disposal, *Activated sludge process, Microbial degradation, Microbiological studies.

The most significant features of the anaerobic digestion and composting ecosystems are summarized and compared specifically in relation to contemporary needs in sludge management. The course of microbial events in sludge is determined by the water content and the presence or absence of porous structure. Consequently, for anaerobic digestion, the sludge is processed in aqueous form, whereas for composting it is processed as a solid material. Anaerobic digestion involves the formation and release of gases, but no inward movement of ambient air. It is a continuous process. Batch processing is not practicable for large-scale operation. Composting involves the formation and liberation of carbon dioxide and water vapor, and unlike anaerobic digestion, requires the movement of ambient air into the mass. In understanding the biological processes at work, three groups of microbial functions are recognizable in anaerobic digestion: solubilization, acid formation, and methane production. The stability of the process as a whole is discussed. While anaerobic digestion and composting are intended to achieve almost identical goals, the mechanisms involved and the extent to which the goals are met differ. Anaerobic digestion is advantageous primarily in requiring less labor for materials handling and in producing methane. Composting is advantageous with respect to pathogen kill, process stability, decomposition of industrial compounds, drying and residue acceptability as related to aesthetic quality and ultimate disposal. Composting would appear to be the superior process for crowded areas where final disposal is on land. (Baker-FRC)
W82-05252

RELATIVE HEALTH RISKS OF ACTIVATED SLUDGE TREATMENT AND SLOW-RATE LAND TREATMENT,
Metcalf and Eddy, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5D.
W82-05258

DRAINABILITY OF AEROBICALLY DIGESTED BIOLOGICAL SLUDGE FROM TEXTILE WASTE,
Auburn Univ., AL. Dept. of Civil Engineering.
J. R. Judkins, Jr., and M. L. Hatcher.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2955-2963, December, 1980. 11 Fig, 4 Tab, 11 Ref.

Descriptors: *Sludge digestion, *Textile mill wastes, *Dewatering, Sludge conditioning, *Sludge disposal, Sludge drying, Sludge thickening, Aerobic digestion, Digestion, Polyelectrolytes, Wastewater treatment, Activated sludge process.

Sludge from a textile finishing mill was aerobically digested in the laboratory. Two-thirds of the total BOD reduction of 75% was attained within the first 7 days. Volatile suspended solids were reduced by 16-34% in 21 days. The non-volatile suspended solids increased during the early stages of digestion and decreased by 19-57% in 21 days for the first batch of sludge and 1-14% in 29 days for the second batch of sludge. Results of dewaterability studies suggested that optimum drainability was achieved at solids detention times of 3-5 days. Increasing the digestion time beyond 5 days decreased drainability. Applying raw, undigested sludge directly to sand drying beds was a feasible process. The drainability was improved by adding a cationic polyelectrolyte. Increasing the dosage of polyelectrolyte slightly decreased the volume of total drainable water. Therefore, an optimum polymer dose will maximize sludge drainage rate without decreasing total drainable water. (Cassar-FRC)
W82-05261

HOW MUCH SEWAGE NITROGEN ON FOREST SOILS. A CASE HISTORY,
Florida Univ., Gainesville. School of Forest Resources.
H. Riekerk.
BioCycle, Vol 23, No 1, p 53-56, January-February, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Forest soils, *Land application, *Sludge disposal, Wastewater disposal, Nitrates, Sulfates, Seattle, Washington, Soil types, Fertilizers, Trees, Plant growth, Waterlogging.

Application of sewage sludge or watewater effluents to forested lands offers several advantages over application to cleared areas. Decomposition is slower under the humid conditions and has a less dramatic environmental impact. Excess moisture is readily removed by transpiration of the trees. Forest soils are usually of low quality and are remote from the human food chain. Even on a 25% slope 0.4 cm dry sludge can be applied without contaminating surface runoff. Nitrates are the main problem for groundwater contamination. Studies on application of sewage to forest soils showed that this is feasible, but the volume must be carefully controlled to avoid surface runoff on slopes, formation of wetlands in level areas, clogging of soil pores with fine particulates, or escape of ammonia into the air. Sludge, 150 to 300 dry tons per ha, was applied to 2 coniferous forest soils near Seattle, Washington, in 1974-77. All treatments significantly increased nitrate and sulfate levels in C-horizon leachates, except in the gravelly soil. The various experimental variables did not significantly affect the nitrate-N or sulfate-S content of output drainage. (Cassar-FRC)
W82-05371

LAND EXTENSIVE PROCESSES FOR WASTEWATER TREATMENT AND DISPOSAL--A PERSPECTIVE,
Water Science Lab., Melbourne (Australia).
For primary bibliographic entry see Field 5D.
W82-05419

TRENDS IN SLUDGE MANAGEMENT,
A. Jacobs.
Water/Engineering and Management, Vol 128, No 12, p 10, December, 1981.

Descriptors: Mercury, Polychlorinated biphenyls, Heavy metals, Legal aspects.

A study of ocean dumping of sludge is reviewed. In their recent report the National Advisory Committee on the Oceans and the Atmosphere (NACOA) recommended that ocean dumping should continue to be permitted under appropriate management control in areas where no unreasonable degradation of the marine environment results. It is believed that ocean contamination is caused primarily by sources other than sludge dumping. Methods for evaluating the costs and hazards of land-based alternatives are needed. At present, land application of sludge is increasing, as is research dealing with application rates, crop selection, and health effects. The Environmental Protection Agency is in litigation over their position that all ocean disposal should be eliminated. (Titus-FRC)
W82-05435

PRESSURE DISTRIBUTION DESIGN FOR SEPTIC TANK SYSTEMS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. J. Otis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 123-140, February, 1982. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Septic tanks, *Design criteria, *Pressure distribution, Septic wastewater, Wastewater, Compaction, High pressure, Load distribution, Clogging.

This paper reviews the principles of pressure distribution network design and presents a simplified design procedure for septic tank systems. The use of pressure distribution networks has been limited primarily to mound systems and large soil adsorption fields. Their use is greatest in Wisconsin, where the networks were first developed. Most are employed in individual home systems, but several of them are employed in community and commercial systems designed for daily flows up to 30,000 gal. The length of service of these systems ranges from 9 years for the individual mound systems to 4 years for the large networks. Limited monitoring of the networks has indicated that this method of distribution retards the development of a clogging mat on the soil's infiltrative surface. Excavation of several systems did not reveal signs of a clogging mat even after 2 years of continuous operation. Mechanical failures have been infrequent. Of more than 500 networks in use in Wisconsin, less than 10 have malfunctioned, with none employing siphons. Pump switch failure is the most common problem, resulting in pump burnout. High quality corrosion proof switches have corrected this problem. One such system serves a butcher shop in which the waste has a high grease content. The grease passed through the septic tank and into the distribution network where it plugged the laterals. More frequent septage removal has corrected this problem. Another system serves an office building. It is not expected that pressure distribution networks will replace conventional designs. However, they are recommended for use in very rapidly permeable soils and soils with shallow restrictive horizons as well as mounds and large absorption field. (Baker-FRC)
W82-05439

INDUSTRIAL WASTE PRETREATMENT AND EPA CADMIUM LIMITATIONS,
Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. R. Zenz, B. Sawyer, E. Guth, and S. Whitebloom.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2538-2551, October, 1980. 4 Fig, 17 Tab, 9 Ref.

Descriptors: *Cadmium, *Effluent limitations, *Industrial wastewater, *Pretreatment of water, *Sludge, *Land disposal, Wastewater treatment, Hazardous materials, Industrial wastes, Waste disposal, Solid wastes, Regulations, Municipal wastewater, Water pollution sources, Pre-treatment standards, Domestic wastes.

The impact of the Solid Waste Disposal Act as it pertains to cadmium (Cd) levels on the treatment of municipal wastes is discussed. The feasibility of using industrial waste pretreatment regulations to reduce sludge Cd levels or allow reasonable sludge application quantities is explored. Implementation of the EPA regulations would severely limit the land application of Cd sludge in the Metropolitan Sanitary District of Greater Chicago under its current land application programs. A comprehensive industrial waste survey was conducted to determine the present industrial discharges of Cd in the district's service area. Only 37.8% of the Cd loading to the treatment plants was from industrial sources. The remaining 62.2% was from nonindustrial sources over which the district has no legal control. Reducing the industrial waste Cd standard from 2.0 mg/l to 0.5 mg/l would have only a minimal effect on the Cd loadings. There has already been a 57.7% reduction in influent Cd loadings since 1971 as a result of strict enforcement of the district's Industrial Waste Ordinance. (Geiger-FRC)
W82-05443

POTENTIAL USE OF EARTHWORMS AS A SOLUTION TO SLUDGE MANAGEMENT,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
R. Hartenstein.
Water Pollution Control, Vol 80, No 5, p 638-643, 1981. 1 Fig, 15 Ref.

Descriptors: *Activated sludge, *Sludge disposal, Sludge digestion, Composting, Earthworms.

Activated sludge, which ordinarily dries as a form with relatively small surface area, has a high potential for putrescence, pathogenicity, and toxicity. A procedure for using a microbivorous earthworm, Eisenia foetida, to convert activated sludge into castings, which have a relatively large surface area and low potential for putrescence, is described. This procedure requires two unit operations: the production of a stock of earthworms (vermiculture) and the use of the stock for conversion of sludge to castings (sludge vermicomposting). An initial supply of E. foetida may be obtained from biological filter beds in many sewage treatment facilities. Vermiculture then involves cultivation of these earthworms in horse manure uncontaminated by urine and harvesting with an inclined rotating drum on a monthly basis. Experimental studies have indicated that anaerobic sludges are not amenable to digestion by E. foetida. One volume of earthworms is placed into 20 volumes of activated sludge containing 12 to 15% or more solids in a layer not exceeding about 30 millimeters. The earthworms appear to convert all the sludge into castings within 10 days at 20 to 25 C. After the solids content is allowed to increase to about 20 or 25%, the worms can be harvested for reuse. Only small losses in earthworm numbers occur in the vermicomposting process. It is suggested that the application of vermiculture to sludge management may provide a reliable, economical, and environmentally beneficial resolution to sludge management problems. (Carroll-FRC)
W82-05478

WASTEWATER MANAGEMENT IN COASTAL NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences.
R. J. Nierstedt, D. A. Okun, C. R. O'Melia, J. K. Sherwani, and M. S. Heath.
Report No. 165, December, 1980. Water Resources Research Institute, North Carolina State University, Raleigh. 208 p, 13 Fig, 50 Tab, 14 Maps, 77 Ref.

Descriptors: *Wastewater treatment, *Wastewater outfall, *Wastewater management, *Coastal waters, *Ocean dumping, Inland waterways, Chlorination, Secodary wastewater, Shellfish, Ecological effects, Aquatic environment, Water circulation, Outfall sewers, Dare County, *North Carolina.

Rapid growth and development in North Carolina have done serious damage to the aquatic environment. The purpose of this study was to evaluate the options for water management in coastal North Carolina, and focused on Dare County in the north and Carteret County in the southern area. Three wastewater management options were examined, with treatment appropriate to the method of disposal; 1) discharge to inland coastal waters; 2) discharge to the ocean; and 3) disposal on land. Options 2 and 3 are the most feasible. Inland coastal waters have poor circulation and the shellfish growing areas are extremely vulnerable to pollution. Ocean disposal is the most environmentally acceptable; however, extensive sewerage is needed to collect the wastewater at a single point for disposal. Four options for ocean disposal are evaluated; primary treatment, with and without chlorination; and secondary treatment, with and without chlorination. The least cost option that provides adequate beach protection in both areas is primary treatment plus chlorination. Ocean outfalls are only economical if they serve large populations, so this study includes an assessment of institutional options available for implementing regional wastewater collection and disposal systems. Primary responsibility would be placed on county governments. The main legal issue to be resolved is authorized for ocean outfalls in North Carolina in the first place and federal constraints on ocean discharge with only primary treatment. (Atkins-Omniplan)
W82-05559

HUMIC SUBSTANCES IN SEWAGE SLUDGES,
Catania Univ. (Italy). Inst. of Agricultural Chemistry.
R. Riffaldi, F. Sartori, and R. Levi-Minzi.
Environmental Pollution, Series B, Vol 3, No 2, p 139-146, February, 1982. 1 Fig, 3 Tab, 25 Ref.

Descriptors: .

The purpose of this research was to make a detailed investigation of the humic compounds of municipal sewage sludges in the form in which they are usually applied to agricultural land. Sewage sludges were collected from ten plants located in Tuscany and receiving wastewater mainly from domestic districts. Two samples were anaerobically digested, while all the other sludges were subjected to aerobic digestion. The results indicate that the content and distribution of humic substances in sewage sludges vary widely, probably depending on the collateral industrial activities in the sewage collection area. No correlation has been sought between differences in the sludges and type of digestion owing to the limited number of plants considered, particularly of those characterized by anaerobic digestion. Sludge humic acids and fulvic acids appeared to be more aromatic and/or constituted by smaller size particles than soil humic acids and fulvic acids. They appear to be classed as a young form of humic substance. It was concluded that although humic carbon in the sludges represents only about 17% of total organic carbon, increasing amounts of these materials applied to agricultural land can effectively supply to the soil a considerable amount of the most chemically and physically active organic matter. (Baker-FRC)
W82-05576

CHANGES TO A SOIL ON IRRIGATION WITH A SANITARY LANDFILL LEACHATE,
State Pollution Control Commissions, Lidcombe (Australia).
K. Y. Chan.
Water, Air, and Soil Pollution, Vol 17, No 3, p 295-304, 1982. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Leachates, *Soil porosity, *Wastewater irrigation, Waste disposal, Waste characteristics, Landfills, Sanitary landfills, Water pollution effects, Irrigation, Ion exchange, Wastewater disposal, Calcium, Magnesium, Soil disposal fields.

Sanitary landfill leachate (pH 10.3 and COD, 1240 ppm) was applied to soil columns containing soil covering samples from a landfill site in Australia. In the month-long expeeriment 370 cm of the leachate was applied to the 40.6 cm long, 9.53 cm diameter soil columns. Soil pH changed from 5 to 10 during the irrigation. The Mg-dominated soil changed to an exchangeable Ca-dominated soil. Mg was displaced by ion exchange at acid pH, but at pH 10, 14.2 meq Mg per 100 g (3 times the cation exchange capacity of Mg) was adsorbed in non-exchangeable forms at the immediate surface of the soil column by specific adsorption reactions. Distilled water applied to leachate-treated soil columns in a simulation of rainfall reduced hydraulic conductivity by 64-fold. This was caused by clay dispersion and reduction in pore space. To avoid death of vegetation and reduction in adsorption efficiency of the soil receiving the leachate, the leachate and soil must first be fully characterized. Then the wastes must be modified by pretreatment, such as dilution, to minimize adverse effects. (Cassar-FRC)
W82-05619

EXAMINATION OF PROCESS PARAMETERS AFFECTING SLUDGE DEWATERING WITH A DIAPHRAGM FILTER PRESS,
For primary bibliographic entry see Field 5D.
W82-05695

MATERIALS BALANCE IN AERATED STATIC PILE COMPOSTING,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5D.
W82-05696

THE XIII OLYMPIC GAMES AND ENVIRONMENTAL QUALITY PERSPECTIVE,
For primary bibliographic entry see Field 5D.
W82-05703

LAND APPLICATION OF SECONDARY EFFLUENT AT LAKE GEORGE, NY,
For primary bibliographic entry see Field 5D.
W82-05704

DIE-AWAY KINETICS OF AEROSOLIZED BACTERIA FROM SPRINKLER APPLICATION OF WASTEWATER,
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5D.
W82-05706

OPTIMAL LOCATION AND MANAGEMENT OF WASTE DISPOSAL FACILITIES AFFECTING GROUND WATER QUALITY,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 5G.
W82-05740

OCCURRENCE OF ENDOTOXINS IN GROUNDWATER DURING THE LAND APPLICATION OF WASTEWATER,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W82-05810

DILUTION OF MUNICIPAL LANDFILL LEACHATE, FRANKLIN COUNTY, INDIANA,
Ball State Univ., Muncie, IN. Dept. of Natural Resources.
For primary bibliographic entry see Field 5B.
W82-05811

RELIABILITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS IN FAIRFAX COUNTY, VIRGINIA,
Fairfax County Div. of Environmental Health, VA.
For primary bibliographic entry see Field 5D.
W82-05812

MODELS OF LANDFILL LEACHING: ORGANIC STRENGTH,
Wright-Pierce Architects/Engineers, Portsmouth, NH.
For primary bibliographic entry see Field 5B.
W82-05817

MODELS OF LANDFILL LEACHING: MOISTURE FLOW AND INORGANIC STRENGTH,
Wright-Pierce Architects/Engineers, Portsmouth, NH.
For primary bibliographic entry see Field 5B.
W82-05818

ORGANIC COMPOSITION OF AEROBIC, ANAEROBIC, AND COMPOST-STABILIZED SLUDGES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological and Agricultural Engineering.
A. J. Higgins, A. J. Kaplovsky, and J. V. Hunter.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 466-473, May, 1982. 4 Fig, 13 Tab, 22 Ref.

Descriptors: *Sludge digestion, *Composting, *Organic matter, Land application, Nitrogen compounds, Anaerobic digestion, Aerobic digestion, Digestion, Chemical oxygen demand, Grease, Organic acids, Volatile solids, Carbohydrates, Amino acids, Cellulose, Lignin, Fatty acids.

The organic matter was characterized in sludge treated by three processes: aerobic digestion, anaerobic digestion, and composting. Compost stabilization produced the most highly oxidized and most innocuous sludge. Anaerobic sludge was least oxidized and had the most potential for creating objectionable odors upon land disposal. Constituents of raw sludge, aerobic sludge, anaerobic sludge, and compost sludge, respectively, were: volatile solids, 75%, 56.5%, 59.9%, and 49.0%; COD (as mg 02 per 100 mg solids), 77.2, 39.6, 49.9, 34.6; carbon, 39.4%, 25.1%, 30.1%, 22.1%; total grease, 11.0%, 4.90%, 4.60%, 5.92%; total unsaponifiables, 2.9%: 3.32%, 3.97%, 3.35%; cellulose, 32.2%; 12.9% 15.7%, 7.2%; and lignin, 13.6%, 9.5%, 12.1%, 10.5%. Also listed are the composition of the free fatty acids fraction, the composition of the glyceride fatty acids, amino acids, tannins, and carbohydrates. (Cassar-FRC)
W82-05854

5F. Water Treatment and Quality Alteration

DYNAMIC PARAMETER TUNING FOR WATER DISTRIBUTION NETWORK MODELS IN AN EXTENDED PERIOD SIMULATION,
Sheffield Univ. (England). Dept. of Control Engineering.
C. M. Rahal, and M. J. H. Sterling.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 151-164, March, 1981. 2 Fig, 7 Tab, 10 Ref.

Descriptors: *Networks, *Water distribution, *Model studies, Simulation analysis, Water supply systems, *Yorkshire Water Authority, Reservoirs, Algorithms, England.

A dynamic parameter tuning algorithm was developed so that results of simulating water distribution systems agreed with actual network operating and calibration data. This algorithm extends the static parameter algorithm so that both may be used for network validation. The dynamic parameter tuning algorithm selects the loads that have the highest sensitivity coefficients for any particular discrepancy and only chooses loads that are applied to the load nodes for which measurements are available. The model handles variations in time and reservoir dynamics. The network model is solved at every time interval and information derived from the balanced model is used to detect the parameters which should be tuned in order to force agreement between simulated and observed data. (Cassar-FRC)
W82-04756

SUPPRESSION OF BREAK POINT PRECHLORINATION BY FAST BIOLOGICAL FILTRATION, COMPARATIVE STUDY OF CLARIFICATION EFFICIENCIES OBTAINED BY SINGLE OR MULTILAYERED BLANKETS (SUPPRESSION DE LA PRECHLORATION AU BREAK POINT PAR FILTRATION BIOLOGIOQUE RAPIDE: ETUDE COMPAREE DE L'EFFICACITE DE DECANTEURS BIOLOGIQUES A LITS FLUIDISES SIMPLES OU SUPERPOSES),
Service de Controle des Eaux de la Ville de Paris (France).
R. Vilagines, A. Montiel, J. Ouvrard, and S. Rigal.
Aqua, No 4, p 86-89, April, 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Water treatment, *Biological treatment, *Filtration, Fluidized beds, *Pretreatment of water, Chemical coagulation, Ammonium, Nitrogen compounds, Organic matter, Organic carbon, Halomethanes, Chlorination, Drinking water, Biological filters, Activated sludge treatment.

Improved purification of water prior to disinfection would reduce the need for disinfectant addition with resultant formation of undesirable compounds such as halomethanes. Biological filtration is a promising pretreatment method, but has suffered from the disadvantages of slow filtration speed and large filter areas. The use of fluidized bed techniques could alleviate these problems. Two pilot plants were set up, one with a single fluidized bed and another with a double oxygenated fluidized bed, for rapid biological filtration of Marne river water. After ten days of maturation the following percent reductions of raw water constituents were achieved: ammonium nitrogen: single bed 22%, double bed 57%; nitrite and nitrate nitrogen: single bed no change, double bed increase; oxidizability, basic: single bed 32%, double bed 19%; oxidizability, acidic: single bed 35%, double bed 28%, taste threshold: single bed 8%, double bed 9%; T.O.C.: single bed 32%, double bed 28%; and halomethane precursors: single bed 30%, double bed 39%. Further water quality improvements could be obtained by subsequent rapid filtration through a 120 cm sand layer at 6 cu m per sq m per hr (ammonium elimination was virtually complete), while slow filtration through adsorbent materials further reduced organic matter content. (Carroll-FRC)
W82-04765

CENTRALIZED CONTROL OF THE WATER SUPPLY COMPLEX FOR THE MARSEILLES URBAN AREA (CONTROLE CENTRALISE DU COMPLEXE D'ALIMENTATION EN EAU DE L'AGGLOMERATION DE MARSEILLE),
Societe des Eaux de Marseille (France). Dept. Adduction et Exploitation.
J. F. Garcin.
Aqua, No 5, p 8, May, 1980. (English summary).

Descriptors: *Water distribution, *Remote control, *Computers, Automation, Sluice gates, *Marseilles, *France, Water treatment, Water quality.

The Marseilles Water Company has introduced a remote control system for its production supply and distribution installations, including the Marseilles Canal, four water treatment stations, and a 2060 km distribution network. The system is based on question-response type transmission equipment using radio transmission, a main and a secondary control center, and 120 stations. The system performs remote signaling, measurement, alarm and instruction functions. It provides data on the positions of the sluice gates in the Canal, pump functioning, water level at different points in the canal, pressures or reservoir levels in the distribution network, and water quality parameters. Two operators are always on duty at the control center. The operators may make use of two system maps, a battery of recorders, and printer, a terminal screen for visualizing various stations, and a control keyboard. Routine and special data are provided, and

commands are initiated from the center. Service to subscribers has been improved by this system. (Carroll-FRC)
W82-04766

ELECTROPHORETIC MOBILITY MEASUREMENTS IN COAGULATION WITH ALUMINUM SALTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, S. G. Vanderbrook, and P. Sricharoenchaitkit.
Journal of the American Water Works Association, Vol 74, No 1, p 44-51, January, 1981. 11 Fig, 1 Tab, 22 Ref.

Descriptors: *Chemical coagulation, *Electrical properties, *Process control, *Aluminum compounds, Silica, Particulate matter, Kaolin, *Alum, Flocculation, Laboratory studies, Hydrogen ion concentration, Colloids, Suspended solids, Separation techniques, *Water treatment.

Studies were made to improve the usefulness of EM (electrophoretic mobility) as a control technique in alum coagulation. Effects of aluminum, salt and initial suspension concentrations and pH were assessed on flocculation efficiencies of particles in batch experiments then the results obtained were comnpared with corresponding electrophoretic mobilities of the particles. At low sulfate concentrations, efficient flocculation was limited to a range of aluminum concentrations that bracket the concentration corresponding to EM = 0. At increasing sulfate concentrations, flocculation increased indefinitely as the aluminum concentration increased. The critical anion (nitrate or sulfate) concentration was negligible at pH values of 3.5-4.5 and above 7.5. At low sulfate concentrations the range of aluminum concentrations which corresponded to flocculent suspensions widened and shifted toward higher aluminum concentrations as the kaolin concentration increased from 50 to 500 mg/1. The aluminum concentration corresponding to zero electrophoretic mobility is essentially directly proportional to the kaolin concentrations. Some evidence was seen that the approximate critical EM value is independent of the type of anion and the particular destabilizing combination of pH and anion concentration. The range of EM values that corresponds to flocculent suspensions seems to depend to some extent on the type of article used in the suspension (silica or kaolin). Results of the study support the contention that hydrolyzed aluminum adsorbs on the particles and forms a coating of aluminum hydroxide precipitate. Addition of aluminum sulfate to a suspension with negligible concentrations of destablizing electrolytes and pH < 7.5 can lead to two regions of flocculation -- a low aluminum flocculation zone corresponding to the destabilization of the positive precipitate coated particles. (Carroll-FRC)
W82-04790

FACTORS AFFECTING COLIFORM BACTERIA GROWTH IN DISTRIBUTION SYSTEMS,
Victoria General Hospital, Halifax (Nova Scotia). Div. of Laboratories.
R. S. Martin, W. H. Gates, R. S. Tobin, D. Grantham, and R. Sumarah.
Journal of the American Water works Association, Vol 74, No 1, p 34-37, January, 1982. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Coliforms, *Water treatment, *Lime, Hydrogen ion concentration, Water distribution, *Halifac, *Nova Scotia, Corrosion, Water quality, Deterioration, chlorination, Pipes, Klebsiella, Bacterial analysis, Lake Pockwock.

A new surface water source, Lake Pockwock, and treatment plant were put into service in Halifax, Nova Scotia, in the summer of 1977. During the summer and fall months up to 30% of the distribution samples showed the presence of coliform bacteria, mainly Klebsiella and other enterobacteria. Postfiltration lime addition at the treatment plant appeared to alleviate the coliform problem. The effects of pH change and lime addition on Klebsiella pneumoniae isolated from the distribution system were investigated in the laboratory. Minimum survival times were found at pH 9.0 and maximum survival times at pH 7.3. Addition of more than 5 mg/liter of lime to raw water caused at least 99% reduction in K. pneumoniae levels. Tubercle material scraped from a pipe removed from the distribution system sustained bacterial growth and reduced a free chlorine residual of 2.5 mg/liter to low levels within 8-14 hr. The strong pH modification and lethal effect on bacteria resulting from lime addition were moderated by the addition of 10 g/liter tubercle material. Lime addition was more effective in controlling the growth of coliform bacteria than increasing the chlorine residual. (Carroll-FRC)
W82-04792

LABORATORY TESTING OF OZONATION SYSTEMS PRIOR TO PILOT-PLANT OPERATIONS,
Vassar Coll., Poughkeepsie, NY.
P. C. Chrostowski, A. M. Dietrich, and I. H. Suffet.
Journal of the American Water Works Association, Vol 74, No 1, p 38-43, 1982. 7 Fig, 5 Table, 34 Ref.

Descriptors: *Ozone, *Water treatment, *Drinking water, Experimental design, *Ozonation, Organic compounds, Oxidation, Biological treatment, Activated carbon, Chemical analysis.

An experimental protocol was designed for bench-scale testing of an ozonation system prior to pilot-plant or full-scale operation. The protocol, a rationalized approach to determination of the chief system parameters, was applied to the ozone pretreatment stage of a biological activated carbon (BAC) process. The need for treatment prior to ozonation was assessed; it was found that the goal of organics removal is best achieved by placing the ozone unit immediately after raw water intake. Comparison of several techniques for quantifying organics removal resulted in selection of an automated system for monitoring UV-absorbing substances at 254 nm. The rates of the ozone-organics and ozone decomposition reactions were determined and used to calculate contact time, contractor volume, optimum alkalinity, and other system parameters. Finally experiments aimed at optimizing the applied ozone dose were conducted. The protocol facilitates system design and is being improved to permit optimization of ozone systems as well as pediction of the effects of ozone in a given system on an individual water supply. (Carroll-FRC)
W82-04795

A SPATIAL COSTING SYSTEM FOR DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 6C.
W82-04796

COMPARISON OF TRIHALOMETHANE LEVELS AND OTHER WATER QUALITY PARAMETERS FOR THREE TREATMENT PLANTS ON THE OTTAWA RIVER,
Health and Welfare Canada, Ottawa (Ontario); and Environmental Health Directorate, Ottawa (Ontario).
R. Otson, D. T. Williams, P. D. Bothwell, and T. K. Quon.
Environmental Science and Technology, Vol 15, No 9, p 1075-1080, September, 1981. 1 Fig, 3 Tab, 24 Ref.

Descriptors: *Halogens, *Methane, *Water quality, Chlorinzation, Potable water, Water treatment, Seasonal variation, Canada, *Ottawa River, Water treatment facilities, Potable water.

A detailed, 13-month study of water quality in three potable water treatment systems obtaining raw water from the Ottawa River in Canada was conducted to complement earlier studies of water quality parameters and treatment practices and studies of factors controlling the production of trihalomethanes (THMs) in potable water treatment systems. Treated water from two plants, which are of similar design and applied conventional coagulation and sedimentation with rapid sand and anthracite filtration, was similar, but differed significantly from treated water from the third treatment plant, which had a different design and used different chlorination practices. Pearson correlation coefficients showed a complex relationship among several water quality parameters. Multiple regression analysis showed that chlorine dosages and demands were the dominant factors controlling chloroform levels, while other parameters displayed minor effects which varied from system to system and according to stage of treatment. Temperature, chlorine dosages and demands, THM levels, alkalinity measurements, and alum dosages all showed pronounced seasonal variation. THM levels varied significantly over a 24-hour period at any particular point in a system. (Carroll-FRC)
W82-04810

FACTORS INFLUENCING FORMATION OF TRIHALOMETHANES IN DRINKING WATER WITH SPECIAL REFERENCE TO SWEDISH CONDITIONS,
National Inst. of Environmental Medicine, Stockholm (Sweden).
H. Norin, L. Renberg, J. Hjort, and P. O. Lundblad.
Chemosphere, Vol 10, No 11/12, p 1265-1273, November/December, 1981. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Chlorinated hydrocarbons, *Disinfection, *Chlorine, *Trihalomethanes, Organic compounds, Drinking water, *Sweden, Chlorine dioxide, Ammonium sulfate, *Water treatment, Water quality control.

Trihalomethane (THM) formation during water treatment with chlorine and ammonium sulfate was studied in full-scale experiments at the Norsborg water works, Stockholm, Sweden. Under normal conditions (0.5 mg per liter C1 and 0.15 mg per liter ammonium sulfate) total THM concentrations increased from 1.8 to 4.1 micrograms per liter within 2 hours. This indicated that drinking water at the tap had a higher THM concentration than water leaving the treatment plant. THM levels decreased with increases in ammonium sulfate doses: 5.1 and 1.7 micrograms per liter THM at ammonium sulfate doses of 0 and 0.35 mg per liter, respectively. THM concentrations decreased with increases in ammonium sulfate/chlorine ratio: 5.1 to 0.9 micrograms per liter THM at ratios of 0 and 1.1, respectively. A high dose of C1 (2 mg per liter) without ammonium sulfate addition produced 70 microgams per liter THM after a 6 day laboratory experiment. Additional laboratory experiments using 2 mg per liter chlorine dioxide produced only 1.8 micrograms per liter THM after 6 days. Sampling of community water disinfected with chlorine dioxide showed only bromodichloromethane present at levels of 0.02 micrograms per liter and no chloroform, dibromochloromethane, or bromoform. Instantaneous THM levels found in water at 191 Swedish water works using some form of disinfection were 0.2 to 200 micrograms per liter. Most of the samples had THM levels of 25 micrograms per liter or below. (Cassar-FRC)
W82-04826

POTABLE WATER PRODUCTION IN HOLLAND.
Water Services, Vol 85, No 1030, p 618-619, December, 1981.

Descriptors: *Drinking water, *Water treatment, *Water supply, *Netherlands, Desalination, Distillation, Surface water, Maas River, Rhine River, *Groundwater, Ground contamination, Activated carbon, Filtration, Dune infiltration.

Annual water production in the Netherlands is approaching the two billion cubic meter mark, yet the provision of water with suitable quality is becoming increasingly difficult. Pollution is threatening Holland's groundwater, which supplies two thirds of the drinking water. Two national organizations are concerned with water recovery and production research. Much research is being conducted in hydrogeology to secure groundwater

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supply. Activated carbon is being used for groundwater purification at some points where chemicals have penetrated through the subsoil into the groundwater. In coastal areas, natural groundwater is too salty for use, except in the case of the coastal dunes. Reservoirs have been constructed on the Maas river, which is less polluted than the Rhine, to equalize the annual flow. Reservoirs have been lined with nylon mats and bitumen, but algae control is still required. Plate clarifiers are widely used for initial purification, followed by sand filtration, carbon filtration if necessary (carbon is obtained from peat in some areas), and chlorination or ozonization for disinfection. Electrochemical and physical purification methods are under investigation. A seawater distillation plant has been constructed on the island of Texel; studies in the Netherlands Antilles have shown that solar distillation plants are feasible. (Carroll-FRC)
W82-04851

NEW TELEMETRY SYSTEM FOR THE CAMBRIDGE WATER COMPANY.
Water Services, Vol 85, No 1030, p 606-609, December, 1981.

Descriptors: *Water supply, *Automation, *Telemetry, *Cambridge Water Company, *England, Computers, Water management, Water quality management.

A complete telemetry control system was installed by the Cambridge Water Company in 1980. The hardware uses standard modules, with communication by UHF radio to 31 outstations and substations. At two minute intervals the system scans the network points, looking for changes of status or exceeding of preset values. In case of abnormal reports, the operator may institute a control function. Values are indicated in user selected units or by color changes. All aspects of system operation are assigned security levels. Only selected records are stored for historical use: data on flow rates in various areas of the network and patterns in daily water supplies. The flexibility of the system allows for expansion and modification. (Carroll-FRC)
W82-04852

THE HYGIENIC CONTROL OF SWIMMING BATHS.
Water Services, Vol 85, No 1030, p 595-597, December, 1981. 2 Fig, 1 Tab.

Descriptors: *Water treatment, *Swimming pools, *Disinfection, Chlorine, Chlorine dioxide, Ozone, Isocyanurates, Filtration, Flocculation, Water circulation, Hydrogen ion concentration.

Water treatment systems employed for maintaining the safety of swimming pool water include flocculation, disinfection, algal destruction and filtration operations. A balance between contaminants introduced and removed must be maintained by fresh water addition and uniform circulation of the water by pumping. The circulation system is generally aimed at circulating the pool contents every 8-10 hr; an average of 2 cu m of treated water should be available for each swimmer. At least 30 liters of fresh water per bather per day should be added to reduce salt accumulation. The addition may be made every 2-3 days when the filters are backwashed. Flocculants are generally aluminum or iron compounds, with the former being more sensitive to pH of the water. Filtration removes both the flocs produced by the flocculants and other small-particulate materials. Disinfection should destroy 99.9% of bacteria present in 30 sec, which can be accomplished by maintaining a redox potential of 700 mV. Sodium hypochlorite solution is the most commonly used disinfectant, but chlorine dioxide, ozone and isocyanurate have also been used. Ozone must be removed by activated carbon filtration after disinfection of the water. Isocyanurates are suitable as simple methods of treatment for small pools. (Carroll-FRC)
W82-04853

DESIGN, CONSTRUCTION AND OPERATION OF A NEW FILTER APPROACH FOR TREATMENT OF SURFACE WATERS IN SOUTHEAST ASIA,
SEATEC International, Bangkok (Thailand).
R. J. Frankel.
Journal of Hydrology, Vol 51, No 1-4, p 319-328, May, 1981. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Water treatment, *Filtration, *Surface water, Gravity filters, Carbon filters, Potable water, Wastewater treatment, Adsorption, Design criteria, *Southeast Asia, Philippines, Thailand.

The development of simple, inexpensive, and efficient water purification and wastewater treatment methods suitable for use in rural communities in Southeast Asia is reported. The filter utilizes local materials that are widely available, principally shredded coconut fiber and burnt rice hulks, in a two-stage filtering process designed as a gravity-fed system. Since the materials are inexpensive enough to discard after use, backwashing is eliminated. Raw water is first passed through shredded coconut fiber for an initial reduction in turbidity and suspended solids removal. This step provides a substitute for the coagulation and sedimenation phases of conventional water treatment plants. The treated water is then passed through the burnt rice husks, removing residual turbidity and bacteria in a manner similar to that accomplished by slow sand filtration in traditional systems, with the additional benefits of taste, color, and odor removal through the absorption properties of the activated carbon in the husks. This system generally does not require the addition of any chemicals. Use of the two filters in series generally produces a clear effluent which is free of odor and color and is of an agreeable and acceptable taste to the villagers. Bacterial removals average between 60 to 90 percent without the use of any disinfectant. Experiences with eight village size units ranging in capacity from 1.0 to 15.0 cubic meters per hour which were constructed in Lower Mekong River Basin countries and in the Philippines are described. (Carroll-FRC)
W82-04869

PRELIMINARY SCREENING OF BACTERIAL COMPONENTS AS ORGANIC PRECURSORS TO THE FORMATION OF TRIHALOMETHANES,
Missouri Water Resources Research Center, Columbia.
R. B. Jacquez, and F. Dolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220633, Price codes: A05 in paper copy, A01 in microfiche. Report, July 31, 1981, 76 p, 12 Fig, 8 Tab, 31 Ref. OWRT A-116-MO(1). 14-34-0001-0127.

Descriptors: *Trihalomethanes, Organic precursors, *Bacteria, *Drinking water, Chloroform, *Chlorination, Iron, *Water treatment, Water pollution sources.

The bacteria from a suspended growth system were studied as organic precursors to the formation of THM's. THM production was monitored as a function of initial chlorine dose and the concentration of bacterial mass as measured by turbidity. Tests were conducted on a batch basis. Ferric iron was also examined for its potential to act as a catalyst for THM production during the chlorination of bacterial cells. In a system saturated with chlorine, chloroform formation was found to increase linearly with the amount of cell mass used as an organic precursor. Chloroform production was also found to increase in relation to a greater exposure of cell surface area (e.g. dispersed cells vs. flocculated cells). Ferric iron appeared to catalyze chlorination reactions in water, causing increased chlorine consumption, but did not increase THM production.
W82-04957

INFLUENCE OF CHLORINATION AND THE DISTRIBUTION SYSTEM ON MUTAGENS IN A POTABLE WATER SUPPLY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-04961

PROSPECTS OF USING RADIATION WATER TREATMENT METHODS,
For primary bibliographic entry see Field 5D.
W82-05026

STUDY OF CHLORINE DIOXIDE AND ITS METABOLITES IN MAN,
Ohio State Univ., Columbus. Dept. of Pharmacology.
J. R. Bianchine, J. R. Lubbers, S. Chauhan, and J. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109356, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-068, December 1981. 3 p.

Descriptors: *Chlorine dioxide, *Toxicity, *Water treatment, *Disinfection, Metabolites, Chlorination, chlorite, chlorate, Chloramine.

Chlorine dioxide has been identified as a potential water disinfectant alternative to chlorination. A three-phase human investigation was undertaken to assess the safety of chlorine dioxide and its metabolites. In phase I, normal healthy adult males were treated with successive increasing doses of chlorine dioxide, chlorite, chlorate, chloramine, chlorine or untreated water. Phase II considered the effect on normal subjects of daily ingestion of disinfectants at a concentrations of 5 mg/L over a 12 week period. In phase III, chlorite, at a concentration of 5 mg/L was administered daily to three glucose-6-phosphate dehydrogenase (G-6-PD) deficient subjects. Physiological impace was assessed by evaluation of a large battery of qualitative and quantitative tests. All three phases of this clinical evaluation were completed uneventfully. there were no obvious undesirable clinical sequellae noted by any of the participating subjects or the observing medical team. In several cases statistically significant trends in certain biochemical or physiological parameters were associated with treatment; however, none of these trends were judged to have physiological consequences. Within the limits of the study, the relative safety of oral ingestion of chlorine dioxide and its metabolites, chlorite and chlorate, was demonstrated. (Moore-SRC)
W82-05057

USE OF MATHEMATICAL MODELS TO GENERATE ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-05072

WATER SYSTEM DESIGN MEETS MODERN CHALLENGES,
Watson and Co., Tampa, FL.
J. L. Carter.
Water/Engineering and Management, Vol 128, No 12, p 33-34, December, 1981. 3 Fig.

Descriptors: *Water supply, *Water quantity, *Water treatment, *Wells, Recreation facilities, Recreation, Filtration, *Drinking water, Water storage, Groundwater recharge, Rainfall, *Tampa, Florida, Water supply systems, Design criteria.

The selection and design of a supplementary drinking water system in Tampa, Florida is described. Three issues were of prime consideration in this undertaking: (1) achieving a yield of 40 million gallons per day, (2) minimizing ecological impact, and (3) conserving energy. This task was further complicated by the fact that the water regime in this area of Florida is highly variable. A recharge area was chosen as the well field. Service road construction was designed to minimize the effect on the natural surroundings, and wells are scattered through the well field, equipped with dual purpose pump houses, which also serve as picnic shelters that blend into the surroundings. Energy conservation is achieved in that gravity is used to move water through the processing facility. (Titus-FRC)
W82-05170

THE USE OF ACTIVATED CARBON IN WATER TREATMENT,
Anglian Water Authority (England).
C. R. Hayes, and C. J. Whitford.
Effluent and Water Treatment Journal, Vol 22, No 1, p 9-16, January, 1982. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Drinking water, *Water treatment, Trihalomethanes, Filtration, Adsorption, Trace levels, Performance evaluation, Taste, Odor control, Economic aspects, Ozone, Oxidation.

Experience of the Anglian Water Authority in use of powdered activated carbon (PAC) and granular activated carbon (GAC) in water treatment is reviewed. Although GAC is more effective than PAC in removing tastes and odors, it is presently being used in only four water works in the United Kingdom, whereas PAC is used in 100 works. GAC removes organic contaminants, but the more volatile compounds are removed effectively only during early bed life. Organochlorine pesticides and other high molecular weight low polar compounds are more effectively adsorbed. If more than 60% of total organic carbon in the range of 4-7 mg per liter must be removed from surface water, GAC is relatively expensive. Ozone pretreatment improves GAC performance, but temperature and other oxidants have little effect. The most attractive option with respect to capital costs is using GAC to replace sand at the rapid gravity filtration stage. The use of GAC is expected to increase with the public concern about trace organic contaminants in drinking water. It is not likely that PAC use will increase. (Cassar-FRC)
W82-05182

SAVING ENERGY BY CATALYTIC REDUCTION OF OXYGEN IN FEEDWATER,
Bayer A.G., Leverkusen (Germany , F.R.).
B. Martinola, and P. Thomas.
Effluent and Water Treatment Journal, Vol 21, No 12, p 542-546, December, 1981. 10 Fig, 5 Tab, 6 Ref.

Descriptors: *Oxygen, *Feedwater treatment, *Catalysts, *Dissolved oxygen, Residual oxygen, *Industrial water, Water use, Water treatment, Energy conservation.

It is virtually always necessary to remove most of the dissolved oxygen from water for steam generating stations, industrial process waters, and heating water in order to avoid corrosion of equipment in which the water is circulating. The most common method used to reduce dissolved oxygen, thermal degassing under vacuum or at slightly increased pressure, is generally inefficient and energy-expensive. Chemical methods, including reduction with sulfite and hydrazine, result in unwanted by-products and are often expensive. The use of hydrogen gas introduced into the water to react with the dissolved oxygen to produce water is a simple process which is also energy-saving. However, the reaction must be accelerated catalytically at low temperatures in order to be completely terminated in a sufficiently short time. Tests were conducted to design a simple reaction unit, to identify a good catalyst, and to determine the optimum operating conditions. Pilot plant tests were conducted to examine design and operating options. Metallic palladium was selected as the catalyst. Ion exchange resins were doped with various amounts of palladium and placed in columns through which water was passed. The size of the individual beads ranged from 0.3 to 1.5 millimeters. An industrial-scale unit for the production of 450 cubic meters per hour of oxygen-free water was constructed. After stoichiometric addition of hydrogen, residual oxygen values of about 20 parts per billion were obtained with a residence time of 30 seconds. There were no signs of fatigue in the catalysis resin after treatment of over 450,000 bed volumes of water. The required apparatus is simple and requires almost no maintenance. The use of this system is recommended wherever the heat used for thermal degassing cannot be recovered. (Carroll-FRC)
W82-05183

BIOLOGICAL DENITRIFICATION FOR POTABLE WATER TREATMENT,
R. Gauntlett, and T. F. Zabel.
Water Services, Vol 86, No 1031, p 17-18, January, 1982. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Denitrification, *Sand filters, *Nitrates, *Water treatment, Fluidized beds, Biological treatment, Filters.

Seasonal high nitrate levels in British rivers and groundwaters used for drinking water supplies prompted investigations of methods of biological denitrification. A fluidized sand bed removed up to 10 mg per liter nitrates with a bed depth of 4-5 m, temperatures as low as 2 C, and an upflow rate of 20 m per hour. Methanol was an effective source of carbon for the denitrifying bacteria; acetic acid produced excessive slime and occasional high nitrate levels in treated water. Sand cleaning and aeratin were necessay parts of the fluidized bed process. The expanded sand bed, an alternative to the fluidized bed, removed 10 mg per liter N at an upflow rate of 14 m per hour, temperatures of 3-5 C, and bed depth of 1.5 m. Backwashing removed excess bacterial growth. Raw water turbidity of > 30 FTU adversely affected performance. The 10-14 day start-up period of the denitrigying process requires anticipation of the high seasonal nitrate levels. (Cassar-FRC)
W82-05247

EXTENDED DECHLORINATION STUDIES WITH GRANULAR ACTIVATED CARBON FILTERS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. T. Suidan, W. H. Cross, and K. A. Chacey.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2634-2646, November, 1980. 14 Fig, 1 Tab, 15 Ref.

Descriptors: *Carbon filters, *Oxidation, *Mathematical models, *Activated carbon, *Residual chlorine, Chlorine, Halogens, *Separation techniques, Water treatment, Wastewater treatment, Disinfection.

When activated carbon which is used to control residual chlorine levels is oxidized by free chlorine, a dark brown color results that renders the product water useless for consumption. An operating procedure has been developed which allows for the removal of column segments that have reached predetermined oxidation levels while permitting a more efficient use of activated carbon. A mathematical model was developed which describes the decreasing bed-length dechlorinator and can simulate the stratified-carbon column in both upflow and downflow operating modes. The model was tested over a wide range of operating and environmental conditions. The extent of carbon utilization prior to elimination and the operating pH had a marked effect on the performance of the system. Bed length had a significant influence on the service life of a carbon dechlorination column. Increased detention of flow resulted in increased carbon utilization efficiency. Higher temperatures also improved performance and extended the service life of a column. Mode-of-flow studies showed that the upflow mode would result in an extended service life of the contactor while allowing for more uniform exhaustion of the carbon along the column. Efforts to use one representative carbon size throughout the column failed due to a redistribution of particle sizes in a stratified bed during carbon removal. (Geiger-FRC)
W82-05257

METHANE IN WATER WELLS,
Michigan Dept. of Public Health, Lansing.
D. K. Keech, and M. S. Gaber.
Water Well Journal, Vol 36, No 2, p 33-36, 1982. 5 Fig, 1 Tab.

Descriptors: *Methane, *Water quality, *Water treatment, Hydrocarbons, Wells, Potable water, Separation techniques, *Water wells, Gases, *Ventilation.

A treatment is described whereby methane and other dissolved gases in water wells can be effectively removed. Proper venting at the well head is essential to allow the methane to be removed from the well. The upward movement of water in the casing when the well is recovering after pumping will push the accumulated methane gas out the top of the well. If large amounts of combustible gases are present, the well vent should terminate above a person's head to avoid ignition by lawnmowers, barbeque grills or other items. The installation of a gas shroud on the submersible pump has been successful in several gaseous water wells. An additional method involves the use of a vented storage tank with a spray bar mechanism. The spray bar is a length of pipe with small holes drilled in it to disperse the water. Agricultural spray nozzles may be used for this purpose. Another method involves the use of an air release valve on a galvanized storage tank. An air-separator system was installed in a newly constructed high school in northern Michigan to solve the gas in water problem there. The air separator is a cylindrical device with an inlet near the top, outlet near the bottom and air vent on top. Water flowing through the unit creates a centrifugal force which causes heavier, gas-free water to move toward the outside. Lighter gas-entrained water moves toward the center due to a low velocity vortex being created within the air separator. Gas rises and exits through a vent line into the top of a vented tank. A vent from the tank terminates about a foot above the roof line of the building. (Baker-FRC)
W82-05262

DEVELOPMENT OF EVALUATION OF ION-EXCHANGE RESINS FOR REMOVAL OF SPECIFIC METALS IN WATER TREATMENT,
West Virginia Univ. Morgantown. Water Research Inst.
A. Winston, C. R. Jenkins, W. Lerdthusnee, and S. J. Masten.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224593, Price codes: A03 in paper copy, A01 in microfiche. Information Report 17, 1981. 22 p, 6 Fig, 2 Tab, 7 Ref. OWRT A-043-WVA(1), 14-34-0001-1152.

Descriptors: Acid mine water, Cation exchange, Chelation, *Demineralization, *Ion exchange, *Iron, *Polymers, *Water treatment, Groundwater, Heavy metals, Industrial wastes, Manganese, Mine water, Treatment, *Wastewater treatment, Water pollution, Water supply.

An ion-exchange resin specific for iron was developed and evaluated for its performance in removing iron from water supplies. The resin was synthesized by converting the carboxyl groups of Chelex 100 (Bio-Rad) to hydroxamic acids by reaction with ethylchloroformate followed by hydroxylamine. The resin was evaluated in bench scale equipment consisting of a column 5 cm in diameter by 1.0 m containing from 0.5 to 1 pound of resin. Iron (III) perchlorate solutions were passed through the column and the iron concentration of the effluent was monitored by atomic absorption spectroscopy. Breakthrough was considered to have occurred when the effluent iron concentration had reached 0.3 ppm. The effects of flow rate and iron concentration on column performance were determined. Increasing flow rate and increasing iron concentration caused decreases in operating exchange capacity of the resin. The exchange capacity varied between 2.9 and 5.8 eq iron per cubic foot of resin depending upon the flow rate and influent iron concentration. The resin can be regenerated by reduction of the iron (III) to iron (II) using sodium hydrosulfite followed by washing.
W82-05282

AUTOMATION OF THE SEINE WATER TREATMENT STATION AT MORSANG AND OF THE WATER SOFTENING STATION AT VILLENEUVE-LA-GARENNE (AUTOMATISATION DE LA STATION DE TRAITEMENT D'EAU DE SEINE A MORSANG ET DE LA STATION D'ADOUCISSEMENT DE VILLENEUVE-LA-GARENNE),
Societe Lyonnaise des Eaux et de l'Eclairage (France).
G. Facy, and P. Musquere.

UNIV. OF ILLINOIS-CHICAGO

Aqua, No 1, p 368-376, 1982. 8 Fig, 10 Ref. English summary.

Descriptors: *Water softening, *Automation, *Control systems, *Water treatment, Paris, France, Water supply, *Seine River, Municipal water.

Examples of automation in two water treatment plants in France are described. The Morsang-sur-Seine plant (150,000 cu m per day) treats water by clarification, sand filtration, ozonation, filtration through granular activated carbon, pH adjustment, and final chlorination. A central computer coordinates all aspects of the system, monitoring water quality parameters at all stages of treatment, operating pumping equipment, regulating flow, dosing chemicals, measuring residual disinfectant, adjusting pH, designating the time for backwash, etc. The Villeneuve-la-Garenne softening plant removes carbonate from 40,000 cu m per day of water. The treatment sequence in this plant is iron removal, nitrification, sand filtration, carbonate removal, dual-media filtration, ozonation, pH correction, and final chlorination. The plant is controlled by a programmable automatic system, regulating circuits according to results of automatic monitoring of water quality and residuals. (Cassar-FRC)
W82-05364

THE CONTINUING STRUGGLE OF WATERBORNE ILLNESS,
For primary bibliographic entry see Field 5C.
W82-05366

DEVELOPMENT OF WATER TREATMENT IN FRANCE (EVOLUTION DANS LE TRAITEMENT DES EAUX EN FRANCE: QUELQUES EXEMPLES D'ACTUALITE),
M. Rapinat.
Aqua, No 1, p 4-9, 1982. 4 Fig, 4 Tab, 53 Ref. English summary.

Descriptors: *Disinfection, *Biological treatment, *Water treatment, *France, Chlorination, Activated carbon, Reviews, Water pollution prevention, Trihalomethanes, Ozonation, Chlorine dioxide.

The status of water treatment in France is reported. Biological processes, based on self-purification, preozonation, and activated carbon, have been developed. Chlorine dioxide and ozone have partially replaced chlorine as disinfectants; ozonation is also effective in removing organic compounds. The efficiency of sedimentation equipment has been improved. Methods to protect water supplies from accidental pollution include storage basins, rapid communications, and shutting down or emptying the treatment plant if necessary. Formation of trihalomethanes is minimized by using chlorine only at the end of the treatment process. Attention to energy conservation and decreasing chemical costs have produced rapidly responding pumping systems, systems for careful control of chemical dosages, and combination chemical-biological treatments. In the future research will center on reduction of Al concentrations, protection of aquifers from nitrate pollution, and sludge treatment. (Cassar-FRC)
W82-05367

TREATMENT OF WATER FROM EUTROPHIED IMPOUNDMENTS,
National Inst. for Water Research, Pretoria (South Africa).
L. R. J. van Vuuren, F. J. de Wet, and G. G. Cillie.
Aqua, No 1, p 354-360, 1982. 7 Fig, 6 Tab, 7 Ref.

Descriptors: *Flotation, *Filtration, *Eutrophication, *Water treatment, Algae, *South Africa, Dissolved air flotation, Coagulation, Pilot tests, Costs, Capital costs, Taste, Odor, Drinking water, Wastewater treatment, Water reuse.

The combined dissolved air flotation-filtration process (DAFF) was successfully applied to treatment of eutrophied surface waters in South Africa. Problems with conventional treatment of these algae-rich waters include frothing of the water, floating flocs, requirement for excessive chemical doses, very short filter runs, caking of filter sand by slime, residual turbidity in finished water, formation of a white deposit on boiling or acidification, and objectionable tastes and odors. Six eutrophied waters treated in the pilot unit included water from several rivers, a secondary municipal wastewater effluent, and a gold mine sewage works effluent. Turbidity was reduced to 0-1.5 NTU, suspended solids to 0.6-6.5 mg per liter, and chlorophyll a to 0-19 micrograms per liter. The process consisted of dosing with alum and polyelectrolyte; air flotation; and filtration through activated carbon, anthracite, and sand. Capital cost estimates for conventional (sedimentation plus filtration), flotation plus filtration (DAF), and combined flotation-filtration (DAFF) treatment were 1,977,000 1,870,000, and 1,386,000 rands (1 rand = $1.27), respectively. Unit costs of the DAFF process were 7.5% lower than for the conventional process. (Cassar-FRC)
W82-05368

CHEMICALS IN WATER TREATMENT--EFFECTS ON WATER QUALITY,
Water Research Centre, Stevenage (England).
T. Burke.
Aqua, No 1, p 351-353, 1982. 1 Fig, 6 Ref.

Descriptors: *Water quality, *Water treatment, *Disinfection, Chlorination, Ozonation, Activated carbon, Adsorption, Trihalomethanes, Chlorinated hydrocarbons, Denitrification, Chemical treatment, Potable water, *Chemical reactions, Adverse effects.

Most chemicals used in water treatment have some side-effects on water quality. In the conventional treatment process coagulants (alum, ferric salts, and polyelectrolytes) may enter the distribution system, producing discolored water, subsequent coagulation, difficulty in maintaining a disinfectant residual, increased corrosion, and residual Al or acrylamide monomer. Possible adverse effects of treating waters corrosive to lead pipes are calcium carbonate precipitation and breakup of deposits on the insides of pipes. Processes for removing excess nitrates include ion exchange and biological denitrification, each of which has drawbacks. The waste brine regenerant solution from the ion exchange process is costly to dispose of. In biological denitrification possible problems are sloughing of excess biological growth and residual methanol (the source of carbon). Chlorination of water produces trihalomethanes and other chlorinated compounds from the organic matter present in surface waters. Health risks of using alternative disinfectants, chlorine dioxide or ozone, have not been fully established. Activated carbon treatment, unless carefully monitored, can release harmful organics into water if the adsorbent is not regenerated before breakthrough occurs. (Cassar-FRC)
W82-05369

OZONE AND ACTIVATED CARBON,
C. Engels.
Aqua, No 1, p 361-367, 1982. 2 Fig, 3 Tab. English Summary.

Descriptors: *Ozonation, *Activated carbon, *Water treatment, *Dusseldorf, *Rhine River, Groundwater, Adsorption, Organic compounds, Taste, Odor control, Toxins.

The water treatment plant at Dusseldorf uses ozonation followed by activated carbon filtration to treat mixed groundwater, predominantly infiltrating through the Rhine River banks. Ozone at a concentration of about 2.5 g per cu m of water oxidizes inorganic compounds (Fe and Mn) and organic compounds (taste and odor producing substances and toxic chemicals). The oxidation products and other materials such as organic chlorine compounds are adsorbed by the activated carbon. In the final stage carbon dioxide is neutralized with NaOH. (Cassar-FRC)
W82-05370

WATER AND WASTEWATER TREATMENT IN LATIN AMERICA--APPLIED TECHNOLOGY,
Universidade Central de Venezuela, Caracas. Dept. of Sanitary Engineering.
G. R. Mijares.
Water Science and Technology, Vol 14, No 1/2, p 431-437, 1982. 17 Ref.

Descriptors: *Technology, *Developing countries, *Water treatment, *Wastewater treatment, *Latin America, Pathogens, Iron compounds, Filtration, Wastewater composition, Lagoons, Stabilization lagoons, Land application, Sludge drying, Disinfection.

During the last 6-7 years Latin America water and wastewater engineers have adapted sophisticated technology from industrial countries to local climates, sewage characteristics, and economic conditions. Some conditions commonly encountered in these countries are: high iron content of deep well water, a high proportion of carbohydrate to protein in wastewater, good tolerance of tropical fish to low dissolved oxygen concentrations, abundance of light energy and warm temperatures, and presence of resistant pathogens and parasites. Engineers have developed process modifications to handle these conditions. Ferrous compounds are oxidized with simple aeration towers, chlorination, or rapid turbulent mixing. High rate sedimentation apparatus made of parallel sheets of asbestos cement inclined at 45-60 degrees from the horizontal have been satisfactorily used in settling of suspended solids. Rapid filtration units operating at declining rates are smaller than conventional units. In these countries wastewater treatment and sludge digester detention times can be less because of higher ambient temperatures and less nitrogenous matter in the sewage. Settling velocity is also greater. Hydraulic and organic loads must be modified to handle specific wastewater compositions. Sewage stabilization lagoons, high-rate photosynthetic lagoons, and land applications show great promise, but the dangers posed by tropical disease organisms must be considered. Sludge drying bed area needs to be only 1/3 of beds in temperate zones. Iodine is being evaluated as a disinfection agent because schistosomiasis and amoebiasis organisms are rather resistant to destruction by chlorination. (Cassar-FRC)
W82-05425

EFFECTS OF SALTS ON ACTIVATED CARBON ADSORPTION OF FULVIC ACIDS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. J. Randtke, and C. P. Jepsen.
Journal of the American Water Works Association, Vol 74, No 2, p 84-93, February, 1982. 19 Fig, 4 Tab, 55 Ref.

Descriptors: *Fulvic acids, *Activated carbon, Adsorption, Calcium, Magnesium, Sodium, *Salts, Water treatment, Drinking water, Potable water.

A study was conducted to more fully characterize the effects of changing concentrations of various salts on activated carbon adsorption and to consider the implications of such effects with respect to the design and operation of treatment systems for organics removal. Fulvic acids were the primary source of organic matter used, as they are considered resonably representative of naturally occurring organic substances in most water supplies. A literature review was included, which concentrated on the effects of nonreactive inorganic salts on the rate and extent of adsorption of anionic and neutral organic adsorbates onto negatively charged adsorbents. Calcium, magnesium, and sodium salts enhanced the adsorption of fulvic acids onto activated carbon. Various inorganic anions had no observable influence on the adsorption of fulvic acid. Calcium significantly influenced the adsorption of fulvic acid by a small activated carbon column. The addition of calcium greatly improved adsorption. The enhancement of fulvic acid adsorption by calcium and magnesium was less pronounced at low pH. Adsorptive capacity was most sensitive to changes in salt concentration at low concentrations of salt, with little adsorption occurring in the absence of added salts. Sodium chloride and sodium sulfate had no effect on the adsorption of fulvic acid when calcium or magnesium was present at a concentration of 0.5 mM. Adsorption

of 2,4-dihydroxybenzoic acid was influenced by salt addition in a manner similar to fulvic acids. Salts do not affect the adsorption of all organic anions in the same manner, as evidenced by the various effects of salts on the adsorption of EDTA, citric acid, and aspartic acid. (Baker-FRC)
W82-05667

REMOVING TRIHALOMETHANE PRECURSORS BY PERMANGANATE OXIDATION AND MANGANESE DIOXIDE ADSORPTION,
Brown and Caldwell, Walnut Creek, CA.
J. M. Colthurst, and P. C. Singer.
Journal of the American Water Works Association, Vol 74, No 2, p 78-83, February, 1982. 15 Fig, 15 Ref.

Descriptors: *Water treatment, *Drinking water, Water quality, Trihalomethanes, Manganese dioxide, Adsorption, Permanganate, Oxidation, Chloroform, Humic acids, Fulvic acids.

The effects of permanganate oxidation and manganese dioxide adsorption on the formation of trihalomethanes from humic substances were investigated. Most of the experiments were conducted with a technical-grade humic acid. Selected experimental runs were duplicated using an aquatic fulvic acid extracted from Lake Drummond, Virginia. Various concentrations of humic material were adjusted to pH 7.0 and contacted with different amounts of permanganate for 2 hours. The study demonstrated that permanganate treatment at neutral pH using doses commonly employed in water treatment practices lowers the chloroform formation potential of humic substances to some degree. The largest decreases occurred in those samples subjected to the greatest permanganate: total organic carbon concentration ratios. Similar decreases in chloroform formation potential were noted for both the humic acid and fulvic acid studied. Manganese dioxide alone did not appreciably absorb humic substances at pH 7.0. Consequently, little reduction in chloroform formation potential can be expected as a result of the presence of manganese dioxide alone. Calcium facilitated the adsorption of humic substances on manganese dioxide. Significant reductions in chloroform formation potential, TOC, and chlorine demand were noted as a result of adsorption of the humic substances on manganese dioxide in the presence of calcium. Humic acid was more easily adsorbed than the aquatic fulvic extract. (Baker-FRC)
W82-05668

EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,
Philadelphia Water Dept., PA.
P. R. Cairo, J. T. Coyle, J. J. Davis, H. M. Neukrug, and I. H. Suffet.
Journal of the America Water Works Association, Vol 74, No 2, p 94-102, February, 1982. 17 Fig, 6 Tab, 16 Ref.

Descriptors: *Activated carbon, *Regeneration, Organic compounds, Carbon, Adsorption, Water treatment, Drinking water, Temperature effects.

Results are presented from ongoing laboratory and pilot-column research comparing the effectiveness of regenerated and virgin carbon for use at water treatment plants. The carbon used in the study was regenerated for one cycle at several furnace temperatures. The laboratory study showed that 542 degrees C regeneration did not restore the fundamental kinetic characteristics of virgin carbon for the test substances methyl ethyl ketone and n-butanol. For these same compounds, the 850 degree C regeneration condition produced breakthrough curves that were virtually identical to the virgin carbon. The pilot column study evaluated 542, 850 and 962 degree C conditions for F400 GAC and two gasification phase regeneration temperatures; for F300 GAC. The most significant results were shown in the breakthrough curves of chloroform for F400 operating in a postcontractor mode. The 962 degree C regenerated carbon produced an effluent concentration twice as high as the virgin, 542 and 850 degree C regenerated carbons. The total organic carbon (TOC) breakthrough curves for all virgin and regenerated F400 GACs were virtually the same. Particularly significant was the fact that the leveling-off plateau of TOC occurred for all virgin and regenerated carbons. The analysis of specific nonpolar organics by GC profiling resulted in the identification of a number of alkyl benzene compounds in the influent that were fairly effectively removed by the virgin and regenerated carbons, even after 17 weeks of operation. It is suggested that the 962 degree C regeneration may be too harsh a condition for drinking water carbon, as it was initially developed for use on carbon heavily laden with organics from industrial and municipal wastewater applications. (Baker-FRC)
W82-05670

CONSIDERING SLUDGE PRODUCTION IN THE SELECTION OF COAGULANTS,
Montgomery (James M.), Inc., Reston, VA.
C. R. James, and C. R. O'Melia.
Journal of the American Water Works Association, Vol 74, No 3, p 148-151, March, 1982. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Coagulation, *Sludge excess, Water treatment, Cost analysis, Alum, Polymers, Orange County, North Carolina, Turbidity, Organic carbon.

Requirements of the 1977 Clean Water Act caused the Orange County, North Carolina, water authority, which discharged its sludge to a stream, to reduce the sludge volume from its water treatment plant by adjusting the coagulation regime. Total organic carbon and turbidity were most effectively removed and sludge production decreased by a combination of alum (30 mg per liter) and a high-molecular weight weakly-charged polymer (0.05 mg per liter). Best results were obtained when alum was added first, followed by polymer. Alum alone produced a difficult-to-dewater, voluminous sludge. Use of polymers alone removed less than optimum total organic carbon, and dosage requirements were high. Costs of the combined treatment for treating water with 27 NTU and 8 mg per liter total organic carbon at a flow rate of 0.24 cu m per sec were $80 per day, compared with $140 per day for alum alone. Costs were calculated using alum at 11 cents per kg and polymer at $6.56 per kg. (Cassar-FRC)
W82-05675

PERFORMANCE OF GRANULAR ACTIVATED CARBON FOR TOTAL ORGANIC CARBON REMOVAL,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and R. S. Summers.
Journal of the American Water Works Association, Vol 74 No 2, p 113-118, February, 1982. 12 Fig, 3 Tab, 21 Ref.

Descriptors: *Activated carbon, *Adsorption, *Organic carbon, Water treatment, Drinking water, Reviews, Mathematical studies, Kinetics, Performance evaluation, Water reuse, Costs, Regeneration.

An overview of a conference concerning the state of the art of oxidation and adsorption techniques in drinking water treatment uses total organic carbon (TOC) as a parameter for measuring removal of collected organics. A total of 47 data sets from 13 investigations (6 from the U.S. and 7 from Europe) were evaluated. Order-of-magnitude agreement was obtained over an extremely broad range of conditions. Partial breakthrough of TOC occurred immediately after startup. This was caused by the influent compounds, which were not amenable to removal by this method. A steady-state condition was attained after about 14,000 bed volumes. At this point, effluent TOC was 25% less than influent TOC because of biodegradation or slow mass transfer into micropores. Adsorption capacity was estimated by subtracting the amount of TOC removed by biodegradation from the total quantity of TOC removed. The adsorption equilibrium capacity calculated from breakthrough data agreed in order or magnitude with equilibrium isotherms measured in laboratory batch studies. Regeneration intervals in multiple paralled-operated units can be significantly reduced by blending the effluents from adsorbers regenerated sequentially. This is especially beneficial in larger plants, 10-38 ML per day capacity. (Cassar-FRC)
W82-05677

REACTIVITY OF HALOGENS WITH AQUEOUS MICROPOLLUTANTS: A MECHANISM FOR THE FORMATION OF TRIHALOMETHANES,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Ddore, N. Merlet, J. De Laat, and J. Goichon.
Journal of the American Water Works Association, Vol 74, No 2, p 103-107, February, 1982. 14 Fig, 1 Tab, 18 Ref.

Descriptors: *Trihalomethanes, *Chlorination, *Organic compounds, Chemical reactions, Disinfection, Water treatment, Chlorinated hydrocarbons, Chlorine, Bromine, Iodine.

The formation of trihalomethanes (THM) by chlorination of organic precursors during the water treatment process depends on many factors. Reactions carried out in stirred reactors showed that the yield of THM was proportional to the concentration of precursor (not necessarily identical to COD) and the quantity of chlorine available for reaction. Maximum yield of THM was obtained at near neutral pH for some precursors (acetylacetone and resorcine1) and at higher pH for other compounds. Some precursors reacted more rapidly with one halogen than another. For example, the methylketone reaction with iodine was much more rapid than the reaction with chlorine. The opposite was true for metapolyhydroxybenzene. Ammonia decreased the amount of THM formed from Cl and Br, but did not affect the reaction with iodine. The formation of total THM during chorination of natural water enriched with resorcinol and different doses of Br decreased with increasing Br concentrations. Under these conditions the chloroform concentrations decreased and bromoform and mixed organohalogen compounds increased. Conclusions reached from these experiments were as follows: (1) at the neutral pH values encountered in water chlorination some compounds such as methylketones present little danger of THM formation, but beta-diketones and metapolyhydroxybenzenes are reactive; (2) halogens react with ammonia in the order Cl > Br > I, and some chloroform is formed during chlorination of ammonia-containing waters; and (3) iodine can be used as a global test for determining THM precursors. (Cassar-FRC)
W82-05678

ADDENDUM TO: EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,
I. H. Suffet, A. Wicklund, and B. Shultz.
Journal of the American Water Works Association, Vol 74, No 3, p 160, March, 1982. 1 Fig, 2 Ref.

Descriptors: *Activated carbon, *Regeneration, *Isotherms, Water treatment, Kinetics, Organic compounds, Methyl ethyl ketone, Adsorption, Trace levels.

An addendum to the original paper, Journal of the American Water Works Association, Vol 74, No 2, p 94, considers isotherm (capacity) and kinetic (column) factors in the evaluation of differing adsorbents. Freundlich isotherms were determined for each constituent of the 4-probe mix (methyl ethyl ketone, 1,4-dioxane, n-butanol, and nitromethane) on each sample of virgin and regenerated granular activated carbon. Four families of isotherms with roughly equal slopes but different vertical distribution were obtained. Nitromethane was not suitable as a probe for regeneration changes, because different regeneration techniques produced no apparent correlation with isotherms. However, methyl ethyl ketone isotherms were indicative of the regeneration methods. Results of the isotherm studies reiterated the general conclusions deduced from laboratory column studies in the original work. (Cassar-FRC)
W82-05680

USDA-NAL, Beltsville Area

MICROBIAL ACTIVITY IN ACTIVATED CARBON FILTERS,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
J. G. den Blanken.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 405-424, 1982. 11 Fig, 4 Tab, 23 Ref.

Descriptors: *Activated carbon, *Water treatment, Filtration, Purification, Drinking water, Bacteria, Adsorption, Oxidation, Filter media.

The oxygen consumption and the removal of organic carbon as well as their relation to one another were studied to obtain information on the adsorption, bacteriological oxidation and desorption processes in filters. The measured oxygen consumption and pH decrease were the result of the bacteriological activity in the filters. The activity of the slow sand filter was comparable with that of the activated carbon filter in respect to bacteriological activity. In the carbon filter the physical and bacteriological processes have to be combined as well as possible. The bacteriological activity in filters can be increased by choosing carbon types with high adsorption capacity for bacteria and for easily degradable substances. To determine the contribution of bacteria to the purification capacity, both the oxygen consumption and the organics removal as well as their ratio have to be studied. In filters without phenol dose the oxygen consumption increased at a water temperature of 20 degrees C during the running time. The purification capacity and the running time are considerably increased by the bacteriological activity in the filters. The Norit RBW carbon type showed more intensive and more constant carbon removal and greater bacteriological activity than the Norit PK carbon types. With the help of phenol as a model substance the kinetics of the biological carbon filtration process can be studied. Under the influence of the copper dose, the pH of the water decreased. Numerous bacteria of various kinds are present on the carbon particles and can oxidize various organic substances. No indication was found that the bacteria present in the filters are harmful with regard to the consumption of the water. (Baker-FRC)
W82-05683

TRIHALOMETHANES IN CHLORINATED COOLING WATERS OF NUCLEAR REACTORS,
Du Pont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
G. J. Hollod, and E. W. Wilde.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 404-408, 1982. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water treatment, *Chlorinated hydrocarbons, *Cooling water, Heated water, Water pollution sources, Fate of pollutants, Nuclear powerplants, Savannah River, Aiken, South Carolina, Organic compounds, Chlorination, Trihalomethanes.

Trihalomethanes (THM) were determined in cooling water before and after chlorination and in the river receiving effluent at the Savannah River nuclear plant, Aiken, South Carolina, in April and November 1980. THM levels (in micrograms per liter) were as follows: Savannah River upstream and downstream of the plant, < 1 to 2; unchlorinated cooling waters, < 1 to 2; chlorinated cooling waters, 12-58. No value exceeded the EPA drinking water guidelines of 100 micrograms per liter. Chloroform and dichlorobromomethane were most abundant, 86-92% and 7-13% of total THM, respectively. Laboratory chlorination experiments with cooling water samples showed that 65 C water produced higher THM concentrations than 25 and 45 C water. However, THM dissipated more rapidly at the higher temperatures than at the lower temperatures. (Cassar-FRC)
W82-05713

EGYPT TACKLES RURAL SUPPLY TASK,
G. Chernock.
World Water, Vol 5, No 3, p 37, 39, March, 1982.

Descriptors: *Water supply, *Rural areas, *Developing countries, *Egypt, Water treatment, Water distribution, Beheira Water Company, Rehabilitation.

Egypt is using the Beheira province as a pilot region for supplying water to poorly served areas. The semi-autonomous Beheira Water Company will control the daily operations of water supply and revenue collection. The projected work on this water system includes rehabilitation of 12 treatment plants and 106 boreholes, installation of 70,000 new water meters, addition of chlorination units to 70 boreholes, improvements in water treatment plant operation, addition of 250 km of distribution system to the present 1500 km, and leak repair. The goal is increasing the present 99,000 cu m per day to meet the needs of 3.5 million people by 1990, at which time 100% of urban households and 90% of rural households should have access to safe water. After water treatment and distribution problems have been solved, the company expects to tackle wastewater disposal. (Cassar-FRC)
W82-05754

RELATIONSHIPS BETWEEN RAW WATER QUALITY, TREATMENT, AND OCCURRENCE OF ORGANICS IN CANADIAN POTABLE WATER,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Directorate.
R. Otson, D. T. Williams, and D. C. Biggs.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 396-403, 1982. 6 Tab, 15 Ref.

Descriptors: *Organic compounds, *Water quality, *Chlorinated hydrocarbons, *Water treatment, Fate of pollutants, Seasonal variation, Chlorination, Trihalomethanes, Hydrocarbons, Aromatic compounds, Chloroform.

Raw and treated water samples from 30 Canadian water treatment plants were analyzed for total organic carbon and for volatile organics. Certain correlations with raw water quality and treatment methods were found. Generally, the highest organics levels were found in summer and in raw and treated river water. Lowest organic levels were in raw and treated groundwater. Treated water had lower or the same levels of total organics but higher levels of halogenated compounds than raw water. The organic materials most commonly found in treated water were chloroform and other halogenated compounds, benzene, toluene, and xylenes. Chlorine dosages ranged from 0.1 to 9.0 mg per liter. The higher dosages and demands usually resulted in high chloroform and bromodichloromethane levels in treated water. Relationships of several compounds with each other and with treatment methods and summer-winter were complex. For raw water there were no significant correlations of chlorine dosages and water quality with organics levels. (Cassar-FRC)
W82-05761

PROTECTING THE SOURCE,
Pirnie (Malcolm), Inc., White Plains, NY.
S. A. Roberts, and S. K. Krishnaswami.
Water/Engineering and Management, Vol 129, No 3, p 28-31, March, 1982. 2 Fig, 3 Tab.

Descriptors: *Water quality, *Management planning, Groundwater, Drinking water, Water resources development, Water demand, Water supply, Resources management.

The first step to be taken in assuring a safe and acceptable public water supply is protecting the quality of its source. Where existing sources are contaminated, properly engineered, built, operated and supervised treatment facilities are needed. Control of contamination must be accomplished by judicious management and oversight of land use and human activities within the watershed involved. Protection of the inland wetlands is vital, as these areas play an important role in natural ecological cycles in terms of water supply sources, plant and animal habitats, flood control, oxygenation of watercourses and entrapment of pollutants, as well as other human needs such as recreation. The Safe Drinking Water Act of 1974 recognizes the importance of source protection in maintaining and enhancing drinking water quality as well as in conserving and protecting groundwater supply. Proper forest management, the creation of vegetative buffer zones on the edges of reservoirs and water courses, and the control of the growth of urbanization consistent with these protective objectives are also essential in order for long term economic burdens to be minimized. Unauthorized disposal of sludge and solid, septic and hazardous wastes within the watershed must be closely tracked and controlled. Unathorized use of herbicides and pesticides must be stopped. Monitoring and inspection programs are vital. Such a program to control and guard the quality of the nation's water requires coordinated, well planned and carefully executed efforts on the part of many people. Such a program, however, would assure maximum protection and obviate the need for expensive water treatment facilities or alternative sources in the long term. (Baker-FRC)
W82-05785

PILOTING MAG-CARBONATE TREATMENT,
Dallas City Water Utilities Dept., TX.
T. E. Taylor, M. E. Bolding, and C. E. Stringer.
Water/Engineering and Management, Vol 129, No 4, p 50, 53-55, April, 1982. 1 Fig, 1 Tab.

Descriptors: *Water softening, *Magnesium carbonate, *Lime, Water treatment, Dallas, Texas, Sludge disposal, Calcium carbonate.

The magnesium carbonate water treatment process was tested in a pilot plant at the Dallas, Texas, Elm Fork plant. The process involves addition of lime and a soluble Mg salt to the raw untreated water. Calcium carbonate and magnesium hydroxide are precipitated. Mg is removed as the soluble Mg(HC03)3, and the CaC03 is recovered and recalcined. The process worked successfully at a feed rate of 60 ppm Mg as carbonate in normal waters and with addition of 15-20 ppm Mg as magnesium sulfate in waters of higher turbidity. Mg recovery was 90% or greater. Sludge production was 3100 lb dry solids per million gallons by the Mg process and 1407 lb per million gallons by the ferric sulfate process. Both processes had the same amount of final sludge disposal solids, but 55% of the Mg sludge was recoverable for reuse. Ultimate sludge disposal for the Mg process was 20-30% of the ferric sulfate process. Sludge recycle at 35-50% of formation rate produced a good particle size for filtration. Although the Mg process requires a larger staff and additional electric power, coagulant consumption and lagoon capacity are reduced. (Cassar-FRC)
W82-05794

CONVERSION OF RAPID GRAVITY FILTERS TO FULLY AUTOMATIC OPERATION USING A PROGRAMMABLE LOGIC CONTROLLER,
North Surrey Water Co. (England).
J. Bowyer-Lowe.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 56-62, 1982. 2 Fig.

Descriptors: *Automation, *Control systems, *Backwash, Filtration, Water treatment, Chertsey Works, Gravity filters, Water treatment facilities.

Operation of the 12 rapid gravity filters at Chertsey Works was automated by application of a programmable logic controller. Backwashing was based on monitoring of filter head loss and filtrate turbidity. The system may be manually controlled if necessary. In the 18 months of operation the logic controller has been 100% reliable in spite of a power failure. The program was not lost at this time. The system proved reliable, easy to program and modify, simple to commission, and reasonable in cost. (Cassar-FRC)
W82-05802

THE CHERTSEY AUTOMATION PROJECT AT NORTH SURREY,
K. Benjamin.

Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 43-56, 1982. 4 Fig.

Descriptors: *Automation, *Control systems, Water treatment, Water distribution, Computers, Chertsey Works, England, North Survey Water Company.

The North Surrey Water Company chose the Chertsey Works for installation of the first system using computers to control water treatment and distribution. This paper describes in detail all the preliminary feasibility and design studies which led to the installation of the system. The main components are: the master control center (microprocessor, storage, monitors, entry keyboard, printer, etc.), nine unit controllers exercising direct local control, and system development equipment for changing programs. The Motorola 6809 was the model chosen for the 14 microprocessors used in the system. The water system is automatically regulated according to predetermined operating levels and pressures. Close real-time servo control is only required for the high lift and gravel well pumps and for chlorine disinfection and residual control. The central controller provides commands to the unit controllers, which are in direct control of the processes. Unit controllers do not communicate with each other. All performance data is logged either automatically or by an operator, and a daily record is printed. (Cassar-FRC)
W82-05805

IMPROVEMENT OF SWIRL CONCENTRATOR,
Centre National de la Recherche Scientifique, Toulouse (France).
For primary bibliographic entry see Field 5D.
W82-05821

5G. Water Quality Control

ON-SITE STORMWATER DETENTION: AN OVERVIEW,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-04758

A PRELIMINARY ASSESSMENT OF MICHIGAN'S PHOSPHORUS DETERGENT BAN,
Michigan Dept. of Natural Resources, Lansing.
J. H. Hartig, and F. J. Horvath.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 193-197, February, 1982. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Phosphorus, *Detergents, *Water quality standards, *Michigan, Wastewater treatment facilities, *Great Lakes, Water quality control, Lakes, Water pollution control.

Michigan's October 1, 1977, ban on phosphorus-containing detergents has reduced total P loadings in the Great Lakes by 20%. Since the ban, total P levels in influents of 58 large wastewater plants in the state decreased 23%, from 6.5 to 4.8 mg per liter, and in effluents, 24%, from 21. to 1.7 mg per liter. P loadings from the Saginaw River to Saginaw Bay decreased 60% over 1976-1979 as a result of the detergent ban, upgraded wastewater treatment, and decreased in flow. P loading for the Detroit River to Lake Erie decreased 50% over the same period as a result of the ban and improved wastewater treatment.No changes in P levels have yet been documented in western Lake Erie. (Cassar-FRC)
W82-04786

ALTERNATIVE APPROACH TO ASSESSING WATER QUALITY IMPACT OF WASTEWATER EFFLUENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, R. A. Jones, and B. W. Newbry.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 165-174, February, 1982. 4 fig, 13 Ref.

Descriptors: *Water quality standards, *Decision making, *Risks, *Water pollution effects, Water quality control, Effluents, Ammonia, Chlorine, Wastewater, Hazard assessment, Toxicity, Environmental effects, Fate of pollutants, Water pollution control.

Water quality assessment should be based on the impacts of contaminants on the desired beneficial uses of the water by man, not on the total concentration of contaminants in a water sample. The hazard assessment approach provides a technically valid basis for evaluating the effects of a contaminant on water quality. It is a sequential, selective testing scheme used to develop information on the toxicology of a chemical and its fate in the environment so that a decision can be made concerning the environmental risks of discharging a chemical. A hazard assessment is conducted in tiers of increasing sophistication and detail with a decision point at the end of each tier. This greatly reduces unnecessary testing and the possibility of overlooking unacceptable risks to water quality. Decision choices at the end of each tier's testing are: not to discharge the substance, to restrict discharge, to allow unrestricted discharge, or to continue testing to gather more information. An exampple of this tiered hazard assessment scheme is given for discharge of toxic domestic wastewater effluent components (ammonia, nitrate, and residual chlorine) into a river. (Cassar-FRC)
W82-04788

MANAGEMENT SYSTEM FOR CONTROL OF PROCESS LOSSES AND SPILLS IN THE KRAFT PULPING INDUSTRY,
Tufts Univ., Medford, MA.
For primary bibliographic entry see Field 5D.
W82-04846

GEOTHERMAL POWER: ACCIDENTAL FLUID RELEASES AND WASTE DISPOSAL,
California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5B.
W82-04911

ENHANCED BIODEGRADATION OF PESTICIDES IN SOIL TO ALLEVIATE CONTAMINATED RUNOFF,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. U. Edgehill, and R. K. Finn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224569, Price codes: A03 in paper copy, A01 in microfiche. November 1981. 22 p 4 Fig, 15 Ref. OWRT A-090-NY(1).

Descriptors: *Soil contamination, *Microbial treatment, *Pentachlorophenol, Soil amendments, Spills, Treatment, *Pesticides, Soil water, Microbial degradation.

Soil inoculation may be a feasible method of rapidly removing some pesticides from contaminated soil in short-term situations, such as when a spill has occurred. Pentachlorophenol (PCP) was rapidly removed from laboratory and field soils by the use of a microbial inoculant. Direct inoculation of 1,000,000 PCP-degrading bacteria per gram of soil containing 120-150 ppm of the pesticide resulted in a PCP half-life of 15 hours under laboratory conditions, whereas the half-life was 14 days without inoculation. In a field test with approximately 100,000 PCP-degradating bacteria per gram of soil containing 100 ppm PCP, a half-life of 2 days was observed. Inoculation was also found to be effective in removing PCP from soil placed in an outdoor shelter. Even though this test was conducted during rather cool weather (8-16 degrees C) and the soil was shielded from the sun, a much more rapid rate of degradation was observed in test soil than in uninoculated control soil.
W82-04967

HYDROGEOLOGY FOR LAND-USE PLANNING: THE POTTER CREEK AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. P. Emanuel, and D. J. Cowing.
Geological Survey Water Resources Investigations 82-86 (open-file report), 1982. 4 Sheets, 14 Fig, 7 Tab, 15 Ref.

Descriptors: *Land use, *Water resources development, Planning, Groundwater, Water quality, Water pollution, Septic tanks, Wastewater disposal, Geohydrologic units, Surface drainage, Soil environment, Wetlands, Snowmelt, Erosion, Hydrologic budget, Urbanization, Land classification, Potential water supply, *Alaska, *Anchorage, *Potter Creek area, Chugach Mountains, *Geohydrology.

The U.S. Geological Survey and the Municipality of Anchorage, Alaska, jointly funded a study of the Potter Creek area to obtain hydrogeologic information for land-use planning. The study area comprises about 16 square miles, from Cook Inlet into the Chugach Mountains. Annual precipitation is about 30 inches, approximately twice that of the lower, main part of the Anchorage bowl. About 31 million gallons of water per day flow through the hydrologic system in the study area. Precipitation contributes 23 million gallons per day; outflow as streamflow is 17 million gallons per day. Surface and ground water were found to be of good quality. Domestic wells were the sole source of water supply in 1980 and most wells tapped bedrock. The average bedrock well is more than 200 feet deep and yields 4.5 gallons per minute; the average well tapping unconsolidated sediments is less than 100 feet deep and yields 7.5 gallons per minute. Wetlands and areas of shallow ground water occupy about 24 percent of the study area. Landslope exceeds 20 percent in more than half the study area. Bedrock is exposed in about a third of the study area. Where maps indicate wetlands or shallow ground water, moderate to steep slopes, shallow bedrock, or surficial materials of low permeability, site-specific investigations can determine suitability for development. (USGS)
W82-04981

HYPOLIMNION OXYGENATION STUDIES IN CLARK HILL LAKE,
Drexel Univ., Philadelphia, PA.
R. E. Speece, C. Givler, R. Aubert, J. Crate, and R. Caire.
Journal of the Hydraulics Division, Proceeding of the American Society of Civil Engineers, Vol 108, No HY2, p 225-244, February, 1982. 17 Fig, 12 Ref.

Descriptors: *Dam effects, *Oxygenation, *Dissolved oxygen, *Hypolimnion, *Water quality control, Dams, Environmental effects, *Fisheries, Thermal stratification, Water quality management, Reservoirs, Lakes.

Large impoundments used for generating hydroelectric power usually have intakes located low on the dam face. After summer stratification of the reservoirs, hypolimnion water is discharged through the turbines, providing a cold water fishery below the dam. Oxygen depletion within the hypolimnion results in low dissolved oxygen (DO) levels in the waters being discharged, which affects water quality as well as downstream fisheries. The economic feasibility of injecting commercial oxygen into the reservoirs was studied in pilot tests conducted at Clark Hill Lake at the Clark Hill Dam, Georgia. Oxygen was injected 130 ft below the surface of the lake at a rate of 100 tons/day (90,700 kg/day) through a diffuser system extending 2,000 ft across the lake 1 mile upstream from the dam. DO was tested in each of the seven turbine discharges to evaluate the efficacy of the system in achieving a 6 milligrams/liter DO standard for discharges below the dam. Hypolimnion oxygenation by on-site production of cryogenic oxygen was estimated to cost $30/ton. An added 6 milligrams/liter DO with 85% absorption efficiency was produced by pulsed oxygen at a rate of 100 tons/day one mile above the dam resulted in a 50% loss of injected oxygen. (Geiger-FRC)
W82-05001

UTILIZATION OF ORGANIC PHOSPHATES BY SELECTED BACTERIA AND ALGAE,
Wroclaw Technical Univ. (Poland). Inst. of Inorganic Chemistry and Metallurgy of Rare Elements.
I. Langowska.
Water Research, Vol 16, No 2, p 161-167, February, 1982. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Phosphates, *Biodegradation, Eutrophication, Water quality, Organic compounds, Reservoirs, *Bacteria, *Algae.

A study was designed to find out whether synthetic phosphates may act as a source of carbon for bacteria isolated from a water reservoir. Studies also were made to determine whether the organic phosphates used could be utilized directly by algae or whether bacteria capable of forming phosphatase enzymes must coparticipate in this process by means of metabiosis. Respiration rates were examined in four bacterial strains for which the only sources of carbon were the phosphorus compounds under study. Glucose was the control. The respiration activities of the four species were different, with the highest activity in glucose being found in Bacillus coagulans. The synthetic surface active agents were relatively readily oxidized by aquatic bacteria. Bacillus coagulans appeared to be the most active of the strains, used since the quantities of oxygen consumed during respiration were much higher than with other bacteria. The effect of phosphorus compounds on growth of algae in pure culture was compared with that on growth of algae in the presence of four bacterial strains. The results indicated that the algae were able to use directly all of the organic compounds studied as a source of phosphorus, except for poly(oxyethylene)dodecylphosphoric acid. The quantity of biomass produced expressed in terms of chlorophyll content varied for different compounds, which indicates that a given compound was more or less available as a source of phosphorus. Good growth of algae in nonbacterial cultures proves that algae possess suitable phosphatases which enable them to utilize a specific organic compound. Not only bacteria but also autotrophic algae may participate in the biodegradation process of organic phosphates, even those which exhibit unfavorable chemical properties for living organisms. (Baker-FRC)
W82-05024

PERFORMANCE TESTING OF THE DIPERNA SWEEPER,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. K. Breslin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109174, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protect Agency Project Summary EPA-600/S2-81-229, December 1981, 8 p, 4 Fig, 2 Tab. 68-03-2642.

Descriptors: *Oil skimmers, *Oil recovery, *Cleanup operations, Oil spills, Water pollution control, Wave action.

The DiPerna Sweeper, a partial-vacuum oil skimmer, was tested in a 2-week program conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT). Forty-three oil recovery tests were run to establish a range of best performance for the skimmer under various environmental conditions in light and heavy oil. The DiPerna Swepper is a self-contained, floating oil skimmer that can operate in either a stationary or advancing mode. Its principle of operation is based upon drawing oil and water into a sealed container by creating a slight vacuum in the container. A floating weir serves as the inlet. The partial vacuum is crated by pumping fluid from the sealed container. The container serves as an oil/water separator. Separator pumps draw water from the bottom of the vessel while others draw oil from the top. The device was able to recover over 75% of the oil presented to it in calm water at low speeds up to 2 knots. The skimmer performed best in high viscosity oil in calm water, and has the capability of collecting oil with less than 5% water. A rdesign of the skimming head and inlet hose should be undertaken to improve the skimming head water ballasting system, to prevent wave splashover response and to prevent turbulence and headwave production while under tow. (Moore-SRC)
W82-05058

PERFORMANCE TESTING OF FOUR SKIMMING SYSTEMS,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte, M. K. Breslin, and G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101353, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-189, October 1981. 8 p, 5 Fig, 4 Tab. 68-03.2642.

Descriptors: *Oil skimmers, *Oil recovery, *Cleanup operations, *Water pollution control, Oil spills, Wave action, Viscosity, Entrainment, Comparison studies.

A test program conducted during the 1979 season evaluated skimmer performance in collecting oil floating on water using several wave conditions, two speeds, and skimmer operating parameters. Tests were conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) on four commercial oil spill cleanup devices. In tests with the Sapiens Sirene, the highest values of recovery efficiency (RE), throughput efficiency (TE), and oil recovery rate (ORR) were obtained during tow tests with waves. Medium viscosity oil was entrained and lost from the system more easily than high viscosity oil because of interfacial shear forces. No oil was lost because of wave splashover. Tests were conducted with the Oil Mop remote skimmer in order to generate design information for future construction of a larger version. The operating limits for this skimmer appeared to depend on two factors; oil mop contact time, and slippage of oil-soaked mops through the squeezing roller assembly. The Troil/Destroil skimmer system has the following operating limits; the maximum towing speed at which the boom can retain collected oil without significant loss is 1 knot; and the maximum pumping rate of the skimmer pump is approximately 37.4 cu m/hr. The versatile Environment Products Arctic Skimmer should be operated at speeds not greater than 2 knots for high efficiency, and to maintain high recovery efficiency a thick oil layer should be maintained at the collection belt. The oil recovery rate of the skimmer is limited by the maximum pumping rate of the skimmer pump. (Moore-SRC)
W82-05059

REMOVAL OF WATER SOLUBLE HAZARDOUS MATERIALS SPILLS FROM WATERWAYS BY ACTIVATED CARBON,
Rockwell International, Newbury Park, CA.
G. R. Schneider.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-103813, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-195, October 1981. 6 p, 5 Fig, 1 Tab. 68-03-2648.

Descriptors: *Hazardous materials, *Cleanup operations, *Activated carbon, *Organic compounds, *Phenol, Spills, Waterways, Mathematical models, Turbulence, Adsorption.

A model of the removal of water soluble organic materials from water by carbon-filled, buoyant packets and panels was developed. Based on this model, equations were derived for removing dissolved organic compounds from waterways by buoyant packets that are either cycled through a water column, or suspended in the waterway by natural turbulence and by panels mechanically suspended in waterways. Assuming that response is required within 1 to 8 hr to an 1,814-kg phenol spill into the Chicago Sanitary and Ship Canal (CSSC), packet cycling with 18,140 kg of activated granular carbon in 897,000 buoyant packets, would require 155 to 368 cycles to effect a 10% reduction in concentration. If it were possible to keep the buoyant packets suspended in the CSSC by turbulence, a response to a 1,814 kg spill in 1 to 8 hr would produce a situation requiring 25 to 60 hr to remove 10% of the spilled phenol, even if the dispersion process were to cease.. A continuing dispersion process will prevent the success of a carbon filled packet approach to cleanup. Carbon panels fixed in a watercourse the size of the CSSC will remove about 4% to a 1,814 kg phenol spill as the polluted fluid passes by the panels, according to the model, if the carbon to phenol ratio is 10. (Moore-SRC)
W82-05060

DEPLOYMENT CONFIGURATIONS FOR IMPROVED OIL CONTAINMENT WITH SELECTED SORBENT BOOMS,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-210650, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-168, October 1981. 3 p. 68-03-2642.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Water pollution control, Containment booms, Harbors, Wave action, Sorbent booms.

Performance tests on three catenary oil containment configurations using sorbent boom sections alone and in conjunction with a conventional containment boom were conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT). Other test varables included wave condition, tow speed, and oil quantity encountered. Maximum no-oil-loss containment tow speed was determined for each wave and oil quantity tested. Use of a sorbent raft inside the apex of a catenary, conventional oil containment boom failed to increase the maximum no-oil-loss tow speed; in fact, no-oil-loss tow speeds increased with the use of sorbent raft apex sections. Conventional boom sides coupled with a sorbent raft apex section increased the no-oil-loss tow speed in calm water and 100% oil capacity from 0.25 m/s for a single-layer totally sorbent boom to 0.29 m/s for a four-layer sorbent raft apex section. similar tests in the 0.3-m harbor chop (HC) wave exhibited a no-oil loss tow speed increase from 0 m/s to 0.22 m/s. Loss of oil occurred mainly at the attachment points of the sorbent raft to the conventional boom sides. Tests using an all sorbent boom with a five-layer sorbent raft apex caused increases in no-oil-loss tow speeds to 0.33 m/s in calm water and 0.17 m/s in the 0.3-m HC.. Attempts at boom regeneration were futile. (Moore-SRC)1c
W82-05062

USE OF SELECTED SORBENTS AND AN AQUEOUS FILM FOAM ON FLOATING HAZARDOUS MATERIALS,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. K. Breslin, and M. D. Royer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108895, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-211, October 1981. 6 p, 7 Fig. 68-03-0490.

Descriptors: *Hazardous materials, *Cleanup operations, *Spills, Water pollution control, Wave action, Adsorption, Naphtha, Octanol, Dioctyl phthalate, Vaporization, *Sorbent materials.

In order to enhance present techniques for handling spills of floating, immiscible hazardous materials, tests were conducted on the effects of sorbent materials and firefighting from on containment, recovery, and vapor suppression. Dioctyl phthalate (DOP), octanol, and naphtha served as the hazardous materials. The sorbent materials were polyurethane foam cubes, Sorbent C, and dow Imbiber beads. As aquesous film forming foam (AFFF), FC-206 was used. Results indicate that introducing sorbents or congealing agents into the hazardous material enables a stable boom to contain the material at a higher current velocity or

tow speed in calm water. The polyurethane foam cubes were most easily distributed and accounted for later. To optimize the effect of sorbents, time for mixing and adsorption of the hazardous material must be allowed. Because the splash-over failure, neither the sorbents nor the Imbiber beads enhanced containment in the presence of 0.3-m harbor chop. Cleanup effort was substantially increased as a result of the use of sorbents. Some tests results indicate that a higher critical tow speed is attainable using AFFF and sorbent rather than sorbent alone. (Moore-SRC)
W82-05063

OIL SLICK MECHANICS,
Rutgers - The State Univ., Brunswick, NJ.
C. A. Osamor, and R. C. Ahlert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105560, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Summary EPA-600/S2-81-199, October 1981. 3 p. R805901.

Descriptors: *Oil slicks, *Oil spills, *Dispersants, *Solubility, *Oil-water interfaces, Cleanup operations, Mathematical models, Saline water, Hydrocarbons, Surface tension, Water pollution control.

Oily discharges to aquatic systems are usually marked by slick formation. The potential for damage by oil spills depends on the rates of the dispersal mechanisms and other factors. Spreading and dissolution of oils in the underlying water are important dispersal mechanisms. The rates of dissolution and spreading of 12 oils were investigated under laboratory conditions. Mathematical models were derived for oils spreading on calm water. The principle forces influencing the spread of oils on calm water are gravitational, viscous, inertial, and net surface tension. The dissolution rates of the oils were determined by measuring their solubilities in water during equilibration in open static tests. Experimental data show increases in oil concentrations initially and decreases later during the period of equilibration. Solubilities were lower in tests with salt water, and the oils attained maximum solubilities at slower rates. Data suggest that as oil slicks equilibrate with water, volatile hydrocarbon species evaporate into the atmosphere from the air/oil interface, and soluble species dissolve into the underlying column of water from the oil/water interface. These processes are not in equilibrium; hydrocarbons continue to evaporate from solution after the oil layer has been depleted of volatile hydrocarbons. The efficiencies of five commercial products for dispersing three oils were evaluated in a large-scale laboratory system. Efficience was found to increase with the volume of dispersant added. The dispersal of spilled oil by application of chemical dispersants appears to be a promising method for cleaning up oil spills. (Moore-SRC)
W82-05064

FEASIBILITY OF COMMERCIALIZED WATER TREATMENT TECHNIQUES FOR CONCENTRATED WASTE SPILLS,
TRW Environmental Engineering Div., Redondo Beach, CA.
M. Ghassemi, K. Yu, and S. Quinlivan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108440, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-213, October 1981. 6 p, 4 Tab, 68-03-2560.

Descriptors: *Wastewater treatment, *Hazardous materials, *Spills, *Cost analysis, *Feasibility studies, Reverse osmosis, Ultrafiltration, Ion exchange, Oxidation, Activated sludge processes, Coagulation, Mobile systems, On-site systems.

Data from the published literature and those obtained from process suppliers provided the data basis for an evaluation of commercial water treatment techniques for on-site treatment of waters containing high concentrations of contaminants that are encountered in hazardous materials spill situations and at uncontrolled waste disposal sites. The techniques include reverse osmosis, ultrafiltration, ion exchange, wet-air oxidation, high-purity oxygen-activated sludge process, ultraviolet-ozone oxidation, and coagulation/precipitation. When used alone, none of the processes considered would be economically applicable to on-site mobile unit treatment of the variety of concentrated wastes encountered, although reverse osmosis, ion exchange, and wet-air oxidation meet many of the application requirements and, hence, require less pretreatment, or post-treatment. The estimated capital costs for a unit suitable for trailer mounting vary from as low as $35,000 for a 227,000 L/day ultrafiltration unit to as high as $1.25 to $1.5 million for a 54,000 L/day two-trailer, wet-air oxidation unit. For short-term operation, the operating cost of the mobile unit is determined largely by nonprocess-specific costs such as transportation, labor, subsistence, analytical support, which vary from situation to situation. (Moore-SRC)
W82-05068

DISPERSANT APPLICATION SYSTEM FOR THE U.S. COAST GUARD 32-FOOT WPB,
Mason and Hanger-Silas Mason Co., Inc., Leonard, NJ.
M. Borst, and G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101684, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-172, October 1981. 2 p 1 Fig. 68-03-2642.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, Water pollution control, Waterways, Oil pollution.

A lightweight, easily assembled system for dispensing chemical dispersants on oil spills was designed to be fitted onto the aft deck of the Coast Guard 32-foot waterways patrol boat (WPB), a vessel stationed in many areas where oils are commonly transferred or transported. It includes two spray booms supported by a rectangular framework. The spray booms are supplied water from the boat's fire fighting system, and chemical dispersant is fed into the water by an eductor. The system could readily be adapted for use on other vessels of opportunity. The only limiting conditions are the ability to provide sufficient height for the spray booms and structural integrity. The system needs an adequate supply of water from an onboard source. For example, the end sections of the support frames could be lashed to the side handrails of most vessels with fore and aft stays secured as convenient. (Moore-SRC)
W82-05069

A MOBILE STREAM DIVERSION SYSTEM FOR HAZARDOUS MATERIALS SPILLS ISOLATION,
Scientific Service, Inc., Redwood City, CA.
J. V. Zaccor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109679, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-219, October 1981. 3 p, 1 Fig, 1 Tab. 68-03-2458.

Descriptors: *Cleanup operations, *Diversion, *Stream pollution, *Hazardous materials, Isolation, Decontamination, Pumps, Pipes, Conveyance structures, Mobile systems,.

Spill cleanup scenarios often involve contamination of small streams by insoluble, sinking hazardous materials. One cleanup approach is to dam the stream above the affected area and bypass the normal flow; this procedure allows the contaminated stream to dry and, thus, facilitates mechanical cleanup. Spill scenarios were analyzed to establish designcriteria for a completely self-contained, independent system that would maintain flow continuity around a region undergoing decontamination processing. The system was designed to use stock items available nationwide, to be easily maintained, and to be readily repairable. To provide flexibility and reliability, the system has been assembled as two totally independent units mounted on trailers. These trailers do not require permits for hauling over state or interstate highways and they can also be moved over unimproved roads to gain access to spill sites. Once onsite, the system can be assembled and placed in operation by a crew of five in a matter of hours. Unit operation and ability to deliver a flowrate of 0.35 cu m a distance of 0.3 km over unprepared ground were evaluated in a shakedown test. The major components of the system are: booster pumps; submerisble pumps; generator; pipes, hose, and fittings; crane; transportation system; and lighting system. (Moore-SRC)
W82-05070

THE EFFECTS OF VARYING CULTURE NITROGEN AND PHOSPHORUS LEVELS OF NUTRIENT UPTAKE AND STORAGE BY THE WATERHYACINTH EICHHORNIA CRASSIPES (MART) SOLMS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Botany and Microbiology.
J. Ower, C. F. Cresswell, and G. C. Bate.
Hydrobiologia, Vol 85, No 1, p 17-22, 1981. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Water hyacinth, *Nutrient removal, *Eutrophication, Aquatic plants, *Nitrogen, *Phosphorus, Fertilizers, Water pollution treatment, Water treatment.

Water hyacinths were cultured for one month in solutions with nutrient levels varying from zero phosphorus and nitrogen to 16.1 ppm P and 36 ppm N. Maximum uptake by the plants was in a culture solution containing 36 ppm N and 6.53 ppm P. Uptake of P was stimulated by elevating either N or P levels or both. N accumulation was inhibited at all levels of P addition. Both N and P levels were highest in leaves and d lowest in roots. The ability of the water hyacinth to accumulate nutrients from eutrohied bodies of water indicates a possible use of this plant for nutrient removal and harvesting as fertifilizer. (Cassar-FRC)
W82-05098

POSSIBILITIES OF OPTIMIZING PROCESSES FORMING THE QUALITY OF NATURAL WATER,
L. A. Sirenko.
Hydrotechnical Construction, Vol 15, No 6, p 319-323, June, 1981. 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 8-11, June, 1981.

Descriptors: *Alagal harvesting, *Eutrophication, *Lakes, Algal control, Water pollution control, *Water quality control, Reservoirs, Cyanophyta, Nutrient removal.

Suggestions for improving the quality of lake and reservoir water in the presence of blue-green algal blooms include reduction of nutrients in water and wastewater entering the reservoirs, construction of buffer zones of trees and grass around water bodies to filter out nutrients draining into the water bodies, use of improved slow-release and encapsulated fertilizers, improvement of fertilizer application techniques to minimize fertilizer losses, aeration of natural water, and large scale removal of excess plant material from eutrophic water bodies. As an example of the last technique, removal of 1 ton of dry seston eliminates 50-150 kg N, 10 kg, P, 50-60 kg of other minerals, and 200-400 kg of organic matter. Removal of 1 kg P leads to a 100 kg decrease in algal production. (Cassar-FRC)
W82-05115

SELECTIVE PASSAGE OF HYDROPHILIC NITROGENOUS ORGANIC MATERIALS THROUGH MACRORETICULAR RESINS,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
For primary bibliographic entry see Field 5D.
W82-05150

ACID POND DRAINAGE,
Science and Education Administration, Columbia, MO.
V. L. Finney.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 49-54, 1982. 5 Fig, 1 Tab, 12 Ref.

LIBRARY U.S. D.A. URBANA-CHAMPAIGN

Descriptors: *Mine drainage, *Neutralization, *Acid mine drainage, Ponds, Settling ponds, Water treatment, *Calcium carbonate, Calcium hydroxide, *Coal mining, Strip mine lakes, Hydrogen ion concentration, Barton County, *Missouri.

It was necessary to neutralize an acid settling pond (pH 2.6) in Barton County, Missouri, before drainage for reconnaissance investigations. Instead of the recommended method of adding lime and calcium carbonate in situ, a two-stage neutralization was done. First 13 tons of calcium carbonate was spread over the water, raising the pH from 2.6 on September 15, 1980, to 4.3 on September 16. The water was then pumped 800 ft into an empty receiving pond in which 10 tons of calcium carbonate had been spread. The entering water flowed over the spread limestone. Turbulence accelerated the escape of carbon dioxide into the atmosphere, driving the neutralization reaction toward completion. The pH of the water was 5.6 by the afternoon of September 16. Costs were 80% less than estimated for the in situ method. After 3 weeks the receiving pond water had a pH of 5.3-6.8. (Cassar-FRC)
W82-05199

HANDBOOK FOR OIL SPILL PROTECTION AND CLEANUP PRIORITIES,
Versar, Inc., Springfield, VA.
J. D. Byroade, A. M. Twedell, and J. P. LeBoff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-183394, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/8-81-002, February 1981. 142 p, 12 Fig, 34 Tab, 44 Ref, 6 Append. 68-03-2648.

Descriptors: *Oil spills, *Cleanup operations, *Water pollution control, *Priorities, Decision making, Environmental effects, Natural resources, Oil pollution, Environmental protection.

Any oil discharge into marine or fresh water systems will inevitably affect both natural and man-made resources. Ideally, all potentially affected resources should be protected from damage, but usually some priorities must be set to adequately use the available manpower and equipment for resource protection. Responsibility for determining priorities for both protection and cleanup lies with the designated on-scene coordinators (OSC). This manual was developed for use by OSC to guide them in assessing priorities during all phases of an oil spill reponse. The guidelines enable the OSC to: determine pertinent facts about a particular oil discharge; identify the resources and installations that may be affected; and establish priorities for protecting and cleaning up these sensitive resources and installations. Special attention is given to response activities such as: determining spill contamination potential; rating area sensitivity to oil contamination; establishing priorities for containment, protection, and cleanup; deciding the best practical containment, protection, and cleanup methods, assessing response effectiveness; and deciding when to terminate cleanup efforts. (Moore-SRC)
W82-05210

THE REHABILITATION OF NORWAY'S LARGEST LAKE,
Norsk Inst. for Vannforskning, Oslo.
K. Baalsrud.
Water Science and Technology, Vol 14, No 1/2, p 21-30, 1982. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Eutrophic lakes, *Phosphorus removal, *Lake restoration, Water pollution effects, Lakes, *Lake Mjosa, *Norway, Eutrophication, Water quality management, Phosphates, Algae, Geosmin, Wastewater treatment.

Lake Mjosa, Norway's largest lake, is long and narrow, with a water volume of 56 cu km and maximum depth of 449 m. Eutrophication, first noticed in the 1960's, progressed to the point of severe algal blooms and formation of geosmin, which made the water undrinkable. Restoration started in 1977 with two objectives: develop wastewater treatment systems and remove phosphorus. Forty-six new treatment plants and 500 km of new sewer pipes were installed, so that 105,000 people of the 115,000 living in urban areas were included in the phosphorus control program as of 1980. Home wastewater treatment for the 85,000 person rural population of the area was financed through direct grants and low-interest loans. Pollution controls were implemented in agriculture and industry. Use of phosphate-free laundry detergents was encouraged. By 1980 the P load was reduced to about 225 tons per year (the goal is 175 tons per year). Signs of eutrophication have been much less apparent. Some blue-green algae are still present, but in small numbers, and lake transparency has improved. In 1980 algal biomass had dropped to 0.8 cu mm per liter from a high of 1.7 cu mm per liter in 1978. Under oligotrophic conditions in 1900 algal biomass was 0.2 cu mm per liter. (Cassar-FRC)
W82-05243

WATER-POLLUTION RESEARCH AND ITS APPLICATION IN DEVELOPING COUNTRIES,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
P. Isaac, and W. Pescod.
Water Science and Technology, Vol 14, No 1/2, p 205-213, 1982. 1 Ref.

Descriptors: *Research priorities, *Developing countries, *Water pollution control, Wastewater treatment, Sanitation, Water pollution sources, Political aspects, Economic aspects, Social aspects, Institutional constraints, Information exchange, Planning, Rural areas.

Water pollution research for developing countries must be directed toward practical applications, taking into consideration the social, political, religious, and financial factors in these poorer rural areas. Sources of pollution in these countries are poor sanitation and disposal of human wastes, industrial effluents, and organically-loaded effluents from food processing (sugar cane, palm oil, and tapioca). Water pollution control efforts by governments are inadequate and ineffective. Research for Third World countries should emphasize development of simple, low-cost systems rather than esoteric subjects such as reaction kinetics. The simple systems should be designed with upgrading in mind. Urban areas can use conventional systems without further research efforts. Demonstration projects are ideal for convincing government officials and local populations of a treatment system's potential. Ex-post-facto analysis of projects too elaborate, too expensive, or unacceptable for social reasons can prevent perpetuation of mistakes. Information transfer throughout the developing world must be facilitated through conferences, organization of published literature, and publishing of research papers by Third World authors. (Cassar-FRC)
W82-05246

AMMONIUM UPTAKE BY MICRONESIAN SPECIES OF GRACILARIA (RHODOPHYTA),
Guam Univ., Agana. Water and Energy Research Inst.
S. G. Nelson, and R. N. Tsutsui.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224858, Price codes: A02 in paper copy, A01 in microfiche. Final Report, Technical Report No 23, May, 1981. 13 p, 3 Fig, 2 Tab, 20 Ref. OWRT A-019-GUAM(1), 14-34-0001-0112.

Descriptors: *Absorption, *Ammonium, *Nitrogen removal, *Bacterial analysis, *Microorganisms, Regression analysis, Nitrogen compounds, Nitrogen fixing bacteria, Water analysis, Kinetics, Biological properties, Water quality, Bioassay, Correlation analysis, Correlation coefficient, Mathematical studies, Evaluation, Baseline studies, *Guam.

Research was carried out to examine the kinetics of ammonium uptake by thalli of several Gracilaria species from Micronesia to evaluate their relative potential for removing ammonium from mariculture systems. It was found that ammonium uptake was dependent upon substrate concentration, and that the uptake kinetics were consistent with a diffusive ammonium uptake process, as shown for ammonium depletion curves of ammonium concentration versus time for each species. Regressions of the log of substrate concentration with time were linear, with correlation coefficients ranging from 0.913-0.996. Uptake rates were independent of light, and were similar during both day and night. Uptake rates were also independent of the thalli nitrogen content. The observed rates of uptake were generally higher for Gracilaria edulis than for other Gracilaria species. The latter observation may be related to thallus morphology. The uptake rates (micrograms ammonium/gram dry thallus/hour) ranged from 0.810-2.184 for Gracilaria edulis, and 0.086-0.722 for other species. The thalli of the Gracilaria species were collected from various locations in Guam and Saipan in the Mariana Islands, and near Malakal Island, Palau. (Zielinski-MAXIMA)
W82-05311

URBAN IMPACTS OF WATER SUPPLY RESERVOIR,
Woodward-Clyde Consultants, Houston, TX.
E. Baca, P. B. Bedient, and R. Olsen.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 73-87, February, 1982. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Reservoirs, *Urban drainage, *Lake Houston, Phosphorus, Nitrates, Sedimentation, *Sediments, Drainage, Water quality, Water supply, Eutrophication, Turbidity, Watershed protection, Texas, *Nutrients, Environmental effects.

This study characterized the lake hydrology and developed nutrient and sediment budgets for Lake Houston, quantified algal productivity as it related to lake water quality characteristics, and suggested a set of management strategies for developing areas to improve the water quality in the lake. The lake was formed in 1954 by an earthfilled dam on the San Jacinto River. Storage capacity of the lake is about 146,800 acre-feet at spillway level and has a surface area of 12,765 acres. Maximum depth is close to 45 ft at the dam, with mean depth of only 12.5 ft. Total drainage area of the lake is 2,828 sq mi and can be divided into the two forks of the San Jacinto River. Most of the solids that come into the lake remain there, while most of the nitrates and half the total phosphorus are lost over the spillway. Sedimentation is controlled by bathymetry, energy and distribution of wind generated waves, location of relict sediments, proximity to sediment source, and man-made barriers. Lower water quality was observed in the West Fork, which represents a rapidly urbanizing area, as compared with the East Fork, which represents an undeveloped, mostly forested area. Storm flows are extremely important because of the washout effect they have on algae and the turbidity that is usually associated with them. Low flows are also important, as they represent critical periods when suspended solids start to settle and more light is allowed to penetrate the water column. Principal management strategies available involve sediment or nutrient load control. Sediment control may be attained by using a system of detention ponds. Nutrient loads can be reduced significantly by better operation of wastewater treatment plants. (Baker-FRC)
W82-05318

SETTLEABILITY OF URBAN RUNOFF POLLUTION,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr., and J. V. Hunter.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1726-1731, December, 1981. 9 Fig, 14 Ref.

Descriptors: *Urban runoff, *Sedimentation rates, *Water pollution sources, Watershed protection, Settleable solids, *Detention reservoirs, Suspended solids, Storm runoff.

The possibility of using dual purpose detention basins for the removal of particulate pollution from

urban runoff is currently under investigation. Tests of urban runoff were conducted to measure the removal of different types of pollutants by sedimentation. Sampling was conducted in five intensively developed areas. Analyses were conducted to determine total phosphate, fecal coliform counts, suspended solids, 5 and 20 day biochemical oxygen demand, nitrates, heavy metals, hydrocarbons, and ammonia. These studies showed that detention of runoff in an undisturbed environment with a water depth of 6 feet for 32 hours resulted in removal of substantial quantities of the common pollutants associated with urban runoff. The settleability data for pollutants showed more scatter than data for total suspended solids. The data for suspended solids, hydrocarbons, and lead indicated that most of the sedimentation of these pollutants was accomplished in 16 hours, but results for other pollutants, particularly copper, were more irregular. Considerable variation was found in the settleability of runoff from different sites. The results of this study did not support the common assumption that pollutants will settle out in amounts proportionate to their respective particulate concentrations. (Carroll-FRC)
W82-05320

OPTIMAL DYNAMIC MANAGEMENT OF GROUNDWATER POLLUTANT SOURCES,
Geological Survey, Menlo Park, CA.
S. M. Gorelick, and I. Remson.
Water Resources Research, Vol 18, No 1, p 71-76, February, 1982. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Solute transport, *Water quality management, *Disposal wells, *Wastewater disposal, Fate of pollutants, Waste management, Wastewater management, Waste disposal, Model studies, Injection wells, Wells, *Groundwater pollution.

A linear programming-superposition method is presented for optimum management of several groundwater pollutant sources (for example, waste disposal) over time so that maximum disposal is accomplished without violating water quality standards. It uses any linear solute transport simulation model to generate a unit source-concentration response matrix to derive the management model. Special simulation model development is not required. The constraints take the form of a series of solute breakthrough curves at supply wells where water quality must be maintained. The matrix shows the concentrations that result at particular locations from solute injections at each of the disposal sites over time. The linear program operates on the matrix to obtain optimal disposal schedules. The method is applied to a sample problem in which three water supply wells must be protected from pollutants injected into three disposal sites over three continuous 200-day periods. (Cassar-FRC)
W82-05345

STATE-OF-THE-ART OF MODELING SURFACE WATER IMPOUNDMENTS,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 2H.
W82-05351

IMPACT OF DISCHARGES AS A BASIS FOR CONTROL MEASURES,
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5B.
W82-05354

NEW TRENDS IN WATER QUALITY MANAGEMENT,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Water Pollution Control.
P. Benedek.
Water Science and Technology, Vol 14, No 1/2, p 47-72, 1982. 10 Fig, 5 Tab, 79 Ref.

Descriptors: *Water quality management, *Sediment transport, *River beds, *Danube River, Model studies, Water supply, Filtration, Bank filtration, Suspended solids, Water pollution control, Fate of pollutants, Adsorption.

A water management system for the Danube River is proposed. This is not based on the classification of surface waters but on the morphological, hydrological, hdyraulic, and technological conditions of drinking water production. The role of micropollutants adsorbed to sediments, neglected in former management schemes, is considered in determining the quality of the bank filtered water supply. A transport model consists of several submodels, including water regime of the river, pollutant dispersion, settling and reentrainment, chemical interactions between wastewater and river water, biochemical processes in bottom sediments, and groundwater flow toward the bank filtering wells. (Cassar-FRC)
W82-05429

INSTITUTIONAL PROBLEMS OF WATER QUALITY PLANNING IN URBANIZING AREAS IN THE PACIFIC NORTHWEST,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-05554

STORMWATER MANAGEMENT IN THE OTTAWA-CARLETON REGION,
Rideau River Stormwater Management Study, Ottawa (Ontario).
H. S. Loijens.
Canadian Water Resources Journal, Vol 5, No 2, p 54-67, 1980. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Storm wastewater, *Combined sewer overflows, Rideau River, Ottawa, Ontario, Bacteria, Planning, Recreation, Swimming, Water pollution control, Water pollution sources, Water quality control, Assimilative capacity, Storm-overflow sewers, Pollution load, Ponds.

Bacterial pollution of the Rideau River flowing through Ottawa, Ontario, forced closing of bathing beaches in 1970. The major pollution source was overflow from combined sewers during rainfall events. Abatement measures included separation of storm and sanitary sewers (scheduled for completion in 1990), installation of pumps to improve water circulation at the most upstream beach, closing of a small sanitary treament plant, and construction of ponds to reduce suspended solids and bacteria levels. A storm water management study of the Rideau River was initiated to study the magnitude and sources of pollutant loads and the hydraulic conditions of the river, to predict pollutant loads from future developments, to determine the assimilative capacity of the river, to determine the effectiveness of present storm water management, to assess the effectiveness and cost of control measures, and to clarify the recreational needs and most practical bathing areas. The 3-year, $1.4 million study began in June 1979. (Cassar-FRC)
W82-05563

STRATEGIES FOR MAINTAINING WATER QUALITY IN TWO BRITISH COLUMBIA LAKES,
Department of the Environment, Victoria (British Columbia).
R. N. Nordin.
Canadian Water Resources Journal, Vol 5, No 3, p 90-101, 1980. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Lake restoration, *Aeration, *Nutrients, Water quality control, British Columbia, Wood Lake, Kalamalka Lake, Water pollution sources, Algae, Eutrophication, Nonpoint pollution sources, Transparency, Phosphorus, Nitrates.

Kalamalka and Wood Lakes, in the Okanagan Valley of British Columbia, are subject to excess nutrient inputs from agriculture and residential development and are separated by only a narrow strip of land. However, they are very different in water quality and morphometry and require different strategies to manage water quality. Kalamalka Lake, 25.8 sq km in area, 142 m deep, is extraordinarily attractive with clear water and low productivity. Wood Lake, 9.3 sq km, 34 m deep, has already suffered significant deterioration in water quality. Water quality control options in Lake Kalamalka are limited to source control (sewers, improved agricultural practices, green belting, erosion control, and improved water quality in Wood Lake). Smaller Wood Lake has several options for improving water quality. Control of internal loading by phosphorus stripping using alum, mixing with other lake waters, and tertiary treatment are impractical and expensive. Aeration may be the most practical method in spite of the 6000-7000 kg per day oxygen demand over the summer stratification period. Other techniques being considered are use of nutrient-rich hypolimnetic water for irrigation and addition of nitrates to the hypolimnion to stimulate the denitrification process. Since lake restoration is still an art in many ways, treatments must be chosen and applied cautiously to avoid adverse effects. (Cassar-FRC)
W82-05567

AGRICULTURAL RUNOFF AND WATER POLLUTION,
Department of the Environment, Victoria (British Columbia). Assessment and Planning Div.
For primary bibliographic entry see Field 5B.
W82-05569

HISTOPATHOLOGICAL CHANGES IN THE LIVER AND BRAIN OF FISH EXPOSED TO ENDOSULFAN INSECTICIDE DURING TSETSE FLY CONTROL OPERATIONS IN BOTSWANA,
Centre for Overseas Pest Research, London (England).
For primary bibliographic entry see Field 5C.
W82-05630

WHERE TO PUT A STEADY DISCHARGE IN A RIVER,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol 115, p 1-11, 1982. 6 Fig, 11 Ref.

Descriptors: *Wastewater outfall, *Design criteria, Effluents, Outfall, Outfall sewers, Rivers, Water pollution control, Mathematical studies, Hydraulics, Wastewater discharge.

In order to avoid high pollution levels along the banks of rivers and streams it is desirable to release effluents from industrial processes and sewage works somewhere near the center of the receiving water body. The position of a single discharge point, or the distribution of multiple discharges, determines the way in which the asymptotic state is approached. The most ambitious target would be to minimize the peak concentration anywhere in the flow. This can be achieved if the discharge rate at each point across the flow is exactly matched to the local volume flow rate, that is, if the constant-concentration asymptote is attained immediately. A more practicable target is to restrict attention to a single discharge point and to minimize the peak concentration at the shoreline. In a straight channel with a symmetric depth profile the shoreline concentration would exhibit such an overshoot unless the outlet were positioned at the center. The question then becomes that of ascertaining the center of a non-symmetric or meandering river. The precise location of the optimal discharge site is at the single zero crossing of the first advection-diffusion eigenmode. Simple examples are described which reveal that this position tends to be weighted toward the inside bank at the beginning of bends. (Baker-FRC)
W82-05632

WATER TEMPERATURES IN NANTICOKE-LONG POINT BAY REGION OF LAKE ERIE,
Ontario Hydro, Toronto. Hydraulic Studies and Development Dept.
For primary bibliographic entry see Field 5C.
W82-05637

MODELING OF PHYTOPLANKTON-NUTRIENT DYNAMICS IN SAGINAW BAY, LAKE HURON,
Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5C.
W82-05639

CHEMICAL CONSTRAINTS OF GROUNDWATER MANAGEMENT IN THE YUCATAN PENINSULA, MEXICO,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4B.
W82-05650

DRYLAND SALINITY IN A CLOSED DRAINAGE BASIN IN NOBLEFORD, ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 4D.
W82-05656

THE COST AND EFFECTIVENESS OF PUBLIC NOTIFICATION OF MCL VIOLATIONS,
Pittsburgh Univ., PA. School of Education.
C. E. Stegman, and G. Schneider.
Journal of the American Water Works Association, Vol 74, No 2, p 59-65, February, 1982. 9 Tab, 2 Ref.

Descriptors: *Water quality standards, *Public relations, Public health, Public rights, Attitudes, Social participation, Water quality, Drinking water, Potable water, Turbidity, Economic aspects, *Cost analysis, Expenditures.

The National Interim Primary Drinking Water Regulations, effective as of June, 1977, require that whenever a community water system fails to comply with any maximum contaminant levels established under the regulations, the water supplier must promptly publish notice of such failure in a newspaper of general circulation in the area serviced by the system or post notices in local post offices. Copies of the notice must also be furnished to local radio and television stations. This study examined maximum contaminant level violations for 164 water systems in 14 states to determine how the water systems notified their customers and how much it cost to do so. Putting an enclosure in the bill and sending a separate mailing are more frequently used than any other direct notification methods. The average cost of public notification for small systems was $31.30 for bacteriologic violations and $30.92 for turbidity violations. The average total cost for large systems reporting turbidity violations was $1218.58. For indirect notification, radio announcements, newspaper articles, and legal notices were all frequently used by the systems. Television stations carried the information as part of their news programs, and thus the water companies did not have to buy air time in this medium. In most cases it was felt that public notification was not effective in either educating or informing the public. Although some felt that consumers are generally indifferent to water problems, others expressed that it was unreasonable to expect customer support, given the delay between the violation and the notification. Concern was also noted that customers might not understand the notices and could in some cases become overly alarmed. (Baker-FRC)
W82-05669

WATER SUPPLY FOR NEW YORK CITY IN THE 1980S,
Olympia and York Battery Park Co., New York.
For primary bibliographic entry see Field 6D.
W82-05671

INVESTIGATING POTENTIAL WATER CONTAMINATION BY PETROLEUM-ASPHALT COATINGS IN DUCTILE-IRON PIPE,
Southern Research Inst. Birmingham, AL. Analytical and Physical Chemistry Div.
For primary bibliographic entry see Field 5A.
W82-05676

CRITERIA FOR ACHIEVING PATHOGEN DESTRUCTION DURING COMPOSTING,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5D.
W82-05697

A CONSISTENT METHODOLOGY FOR WASTELOAD ALLOCATIONS,
Hays and Lindsey, Inc., Austin, TX.
A. J. Hays, Jr.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2994-2997, December, 1980. 2 Fig.

Descriptors: *Assimilative capacity, *Waste load, *Water quality standards, Streamflow, Ouachita River, Louisiana, Model studies, Flow measurement, Low flow.

Steady-state models for estimating the assimilative capacities of stream segments can give overly conservative results under some circumstances. An example is a 161 km segment of the Ouachita River, Louisiana, in which the difference between the actual and predicted time-of-travel through the segment for the 7-day low flow was 86 days. Use of more complicated dynamic models can be avoided by using a graphical approach wherein low flow is determined intuitively by the intersection of two curves: the estimated travel time vs. Steady-state flow rate through the river segment and the frequency relationship between the 2 or 10 year low flow and the n-day flow averaging period used. In the Ouachita River segment the wasteload allocation computed by this method was 70% greater than by the previous method. (Cassar-FRC)
W82-05702

POISONS IN THE HUDSON,
C. S. Warren.
Clearwaters, Vol 10, No 2, p 12-13, June, 1980.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Water pollution treatment, Hudson River, New York, Organic compounds, Chlorinated hydrocarbons, Rivers, Dredging, Legislation.

Although polychlorinated biphenyls (PCB) input to the Hudson River has been discontinued, river bed sediments remain highly contaminated. A plan to dredge 40 'hot spots' with average concentrations of 51-155 micrograms per g PCB has been developed. An estimated 1.8 million cu yards of material containing 277,600 pounds of PCB would be dredged and placed in a secure landfill built for this purpose. Total costs are estimated at $30 million for the 3-year project. Funds are not available at present to finance this cleanup. The EPA supports Superfund legislation as a means of implementing these plans. (Cassar-FRC)
W82-05705

ELECTRICAL INTERACTION BETWEEN POLARIZED WATER MASSES AND ZOOPLANKTON IN WATER BODIES,
Akademiya Nauk SSSR Leningrad. Inst. Ozerovedeniya.
V. V. Aleksandrov.
Hydrobiological Journal, Vol 16, No 5, p 11-17, 1980. 3 Fig, 30 Ref.

Descriptors: *Zooplankton, *Lakes, *Electric fields, Water pollution effects, Lake Ladoga, USSR, Rotifers, Infusoria, Pulp and paper industry, Polarization, Eutrophication, Plankton.

The electric field and the distribution of zooplankton were studied on June 23, 1974, at 16 stations in Lake Ladoga, USSR, part of which was polluted with paper mill effluents. The electric field values were more negative in areas where rotifers and infusoria were more abundant. In unpolluted water the electric field was 5-10 times 10 to the minus 5th power V per m and the number of hydrobionts, 200 specimens per liter. Concentrations of 748 total plankton specimens per liter were found in water with electric field values of -1 to -1.2 times 10 to the minus 4th power V per m. The boundary zones between polluted and unpolluted water were rich in plankton. Two possible explanations for the difference in electric field gradient and the abundance of microorganisms were given. Eutrophication leads to an abundance of saprophytic bacteria which attract large numbers of zooplankton. On the other hand, electrostatic forces may attract charged microorganisms in the boundary zone between polluted and unpolluted water and hold them there until the gradient disappears as a result of dilution. (Cassar-FRC)
W82-05707

TRANSPORT OF NITRATE AND GASEOUS DENITRIFICATION IN SOIL COLUMNS DURING LEACHING,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-05709

TRIHALOMETHANES IN CHLORINATED COOLING WATERS OF NUCLEAR REACTORS,
Du Pont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5F.
W82-05713

SLASH BURNING EFFECTS ON SOIL AND WATER CHEMISTRY IN SOUTHEASTERN ALASKA,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 4C.
W82-05715

METHOXYCHLOR RESIDUES IN TREATED IRRIGATION CANAL WATER IN SOUTHCENTRAL IDAHO,
Idaho Univ., Moscow. Twin Falls Cooperative Extension Service.
For primary bibliographic entry see Field 5B.
W82-05726

MUTAGENIC POTENTIAL OF WATER CONCENTRATES FROM THE EFFLUENT OF A WASTE OIL STORAGE POND,
Texas A and M Univ., College Station. Dept. of Soil and Crop Science.
For primary bibliographic entry see Field 5C.
W82-05727

OXYGENATION OF THE AVON RIVER,
Ontario Ministry of the Environment, Toronto.
D. Huber, D. Veal, and J. Goldman.
Water and Pollution Control, Vol 120, No 2, p 38-39, March/April, 1982.

Descriptors: River water, *Oxygenation, Rivers, Water quality, Aquatic plants, Respiration, Oxygen, Avon River, *Canada, Water quality management, *Aeration, *Instream aeration, Dissolved oxygen.

Water quality in the Avon River is affected by agricultural drainage and by urban inputs from the City of Stratford, Ontario, Canada. One major problem is low dissolved oxygen levels during summer night-time periods, resulting from the respiration of heavy growths of aquatic plants. An assessment was made of in-stream oxygenation of the river water. Oxygen was injected into the pumped water at a constant rate of 5.00 cubic meters per hour. With the 0.028 cubic meter/second flow of river water through the pumping system, the injected oxygen was estimated to have increased by oxygen concentration in the diffuser by 75 mg/liter. The estimated velocity of the river was 0.37 km/hr. Hence, it would take the river 10.8 hours to travel from the point of injection to an area 4.0 km downstream where the last dissolved oxygen monitor was located. Only localized benefits were obtained from this procedure because as the river moved on downstream, night time plant respiration would gradually offset the improvements of the oxygenation. After several

hours of travel away from the oxygenator, equating to about 1-3 river km, day-time conditions would result in natural oxygen recovery from plant photosynthesis. In order to substantially improve the night time oxygen status of a lengthy river, a number of oxygenation units would be needed. (Baker-FRC)
W82-05730

A SENSITIVITY AND ERROR ANALYSIS FRAMEWORK FOR LAKE EUTROPHICATION MODELING,
For primary bibliographic entry see Field 5C.
W82-05739

OPTIMAL LOCATION AND MANAGEMENT OF WASTE DISPOSAL FACILITIES AFFECTING GROUND WATER QUALITY,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
S. M. Gorelick, and I. Remson.
Water Resources Bulletin, Vol 18, No 1, p 43-51, February, 1982. 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Optimization, *Waste disposal, *Groundwater pollution, Water quality control, Simulation analysis, Numerical analysis, Solutes, Linear programming, Water supply, Aquifers, Groundwater management, Water pollution prevention, Path of pollutants.

Groundwater systems which are used for both waste disposal and water supply must be properly managed to ensure long range water quality protection. Numerical simulation of groundwater solute transport can be used in combination with linear programming to optimize waste disposal. Two management problems are described. In the first problem, waste disposal at potential sites is maximized while maintaining water quality at supply wells and operating an existing disposal facility. An iterative procedure is used to deal with changes in the velocity field induced by wastewater injection, which causes a nonlinearity in the solute transport equation. The value of parametric programming in analyzing waste disposal tradeoffs among existing and potential facilities is demonstrated. The second problem addresses the evaluation of a groundwater system in order to identify all sites which are suitable for subsurface waste disposal. This management model is manipulated so that the optimal values of the dual variables provide information with respect to the utility of each potential disposal site. The joint simulation and optimization approach permits optimal evaluation, selection, and management of groundwater waste disposal facilities where the aquifer is also used for water supply. (Carroll-FRC)
W82-05740

DUAL OBJECTIVE CONTROL OF NUTRIENT LOADING INTO A LAKE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
L. Duckstein, I. Bogardi, and L. David.
Water Resources Bulletin, Vol 18, No 1, p 21-26, February, 1982. 3 Fig, 6 Tab, 29 Ref.

Descriptors: *Nutrients, *Management planning, *Water pollution control, *Lakes, Eutrophication, Monte Carlo method, Multiobjective planning, Stochastic process, Phosphorus, Watershed management, Lake Balaton, Hungary, Model studies.

A framework is presented for multiobjective modelling of nutrient loading reduction from a watershed into a water body. Lake Balaton, Hungary, is used as a case study. The nutrient phosphorus was chosen for examination since it appears to be the limiting factor of eutrophication in this lake, which has experienced rapid development of tourism around the lake and of agriculture over the watershed. Although about 50% of the overall phosphorus loading originates from nonpoint sources, the mechanism is poorly understood and few observation data are available. While the objective of eutrophication control is to minimize phosphorus loading, the objective of watershed management is to maximize agricultural revenue. A discrete set of alternative methods for controlling nutrient loading is defined, which comprises a mix of control alternatives for the following elements: point sources, runoff, fertilizer type and application, cropping management, erosion, and sedimentation. A previously developed stochastic model is used to estimate the probability density function of dissolved and fixed phosphorus loading which reflects the control policy. A compromise solution can then be selected as a mix of the best-ranked policies. (Carroll-FRC)
W82-05750

STORMWATER MANAGEMENT - ONE DEVELOPER'S EXPERIENCE,
Major Holdings Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 6B.
W82-05777

A CITIZEN'S VIEW OF WATER MANAGEMENT IN THE OKANAGAN VALLEY,
For primary bibliographic entry see Field 6G.
W82-05781

AQUIFER MANAGEMENT IN DADE COUNTY,
Dade County Dept. of Environmental Resources Management, Miami, FL. Environmental Planning Div.
D. Yoder.
Water/Engineering and Management, Vol 129, No 4, p 34-38-40,42, April, 1982. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Aquifer management, *Land use, Dade County, *Florida, Biscayne Aquifer, Salt water intrusion, Organic compounds, Trihalomethanes, Chlorinated hydrocarbons, Pesticides, Wells, Groundwater pollution, Nitrates, Water management, Water quality control, Planning, Monitoring, Agriculture, Water supply, Nonstructural alternatives.

Early water management activities in Dade County, Florida, focused on drainage works. This lowered groundwater levels and allowed salt water intrusion into coastal aquifers. In 1975 the county Department of Environmental Resources Management (DERM) was designated the 208 areawide water quality planning agency. In 1979 the Biscayne Aquifer was named as a sole source aquifer as a result of studies undertaken by the DERM. The Department monitored nitrates in canals during and after storm events and in groundwater and found levels high, but not generally exceeding the 10 mg per liter standards. Sources of the nitrates were determined by monitoring at 26 selected sites for a year. The major contributor was, as expected, agriculture. A voluntary and educational control program is being developed to minimize the agricultural sources of nitrates. Volatile organics (trihalomethanes and industrial chemicals) are another concern. No pesticide contamination has been evident to date. Mean average volatile organics for all wells are 4.9 micrograms per liter in the wet season and 6.3 micrograms per liter in the dry season. An ordinance regulating land use around public water supply wells is being prepared. No new activities involving the use of hazardous materials would be permitted within the 210-day hydraulic travel time, which represents the highest recorded period without recharge from rainfall. Other agencies involved with water management in this region are the state Environmental Regulation Department, the South Florida Water Management District, and the U.S. EPA. Plans cited for development are new management practices for storm water disposal, improved septic tank regulations, a more active public information and education program, and expanded monitoring of water resources. (Cassar-FRC)
W82-05784

THE SAFE DRINKING WATER ACT ON REVIEW,
Johnson (C. C.) and Associates, Inc., Silver Spring, MD.
C. C. Johnson, Jr.
Water/Engineering and Management, Vol 129, No 3, p 14-15, March, 1982. 1 Ref.

Descriptors: *Drinking water, *Legal aspects, Legislation, Safe Drinking Water Act, Public health, Water treatment, Regulations, Standards.

The legislative history of the Safe Drinking Water Act is reviewed as an aid to understanding several of the suggested changes in the legislation, since the authorizing legislation for the act will expire in September 1982. The major concern of some advocates for change is the discretion given to the Environmental Protection Agency to regulate drinking water contaminants which in the judgment of the administration may have an adverse effect on human health. Another issue under debate pertains to the administrator's authority to require a specific treatment technology. A third major concern of the public and suppliers is the economic impact of the Act on small water supplies. Many other issues have been raised in the debate over the Act, including subjects associated with public notification, health advisories, risk analysis, benefit-cost analysis, operation and maintenance regulations, and a host of others. (Baker-FRC)
W82-05792

OUTFALL DIFFUSER BEHAVIOR IN STRATIFIED AMBIENT FLUID,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05797

LAW FOR ENVIRONMENTALISTS,
V. Sikora.
Journal of Environmental Health, Vol 44, No 5, p 258-259, March-April, 1982.

Descriptors: *Waste disposal, *Environmental protection, Permits, Hazardous materials, Legal aspects, Regulations, Sewage disposal.

Various problems in on-site sewage disposal are discussed, and an unusual way in which a county tried to resist the siting of a hazardous waste disposal facility is presented. Developments in administrative inspections in states are also cited. The problems presented deal with the denial of an on-site sewage disposal permit to a developer for his lots if they are unsuitable, even though there is no other use which can be made of the lots; the prohibiting of holding tank sewage disposal systems in coastal areas; the authority of a state health department to establish regulations for subsurface sewage disposal; and the justification for requiring permits to be obtained from different two state environmental agencies for an on-lot disposal system. (Baker-FRC)
W82-05813

THE NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS, PART I - HISTORICAL DEVELOPMENT,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
W. A. Oleckno.
Journal of Environmental Health, Vol 44, No 5, p 236-239, March-April, 1982. 22 Ref.

Descriptors: *Drinking water, *Regulations, Potable water, Water quality, Standards, Legal aspects, Federal Jurisdiction, Public health, Water pollution.

This article is the first of a two part series dealing with the National Interim Primary Drinking Water Regulations as they apply to community water systems. The historical development of the Regulations is presented. They result from two nationally significant historical events: the promulgation and revision of the U.S. Public Health Service Drinking Water Standards of 1962 and the enactment of the Safe Drinking Water Act of 1974. These regulations were the first comprehensive set of drinking water standards applicable to all public water systems in the United States. It was the substandard condition of water supply systems in the United States as well as reports of suspected carcinogens in the New Orleans drinking water supply that underscored the need for the regulations and pro-

vided the motivation for their legislative mandates. In a February 1969 study, 41% of the water supply systems studied did not meet the limits established in the 1962 Drinking Water Standards; 56% were deficient in aspects of source protection, disinfection, clarification and/or pressure in the distribution system; 90% of the systems collected an insufficient number of bacteriological samples and/or collected samples showing poor bacteriological quality. While the Safe Drinking Water Act called for the eventual establishment of revised primary drinking water regulations after a detailed study of the health effects of contaminants in drinking water, no such standards have yet been proposed. (Baker-FRC)
W82-05814

THE NATIONAL INTERIM PRIMARY DRINKING WATER STANDARDS. PART II. IMPACT ON COMMUNITY WATER SYSTEMS. THE INDIANA EXPERIENCE,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
W. A. Oleckno.
Journal of Environmental Health, Vol 44, No 5, p 240-244, March-April, 1982. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Drinking water, *Standards, Water quality, Legal aspects, Legislation, *Indiana, Regulations, Federal Jurisdiction, National Interim Primary Drinking Water Regulations, Surveys.

The impact of the National Interim Primary Drinking Water Regulations (NIPDWR) on Community Water Systems (CWS) in Indiana was investigated. The current study was designed to determine to what degree the major provisions of the NIPDWR impacted on CWS in Indiana; how system size, source of water supply, and system ownership related to the reported impacts; and what steps had been taken or planned to reduce the major impacts. A total of 190 questionaires, representing 63.3% of those mailed, were returned. Of these, 4.7% were unusable. The final usable sample appeared to be reasonably representative of the population of Indiana CWS both geographically and in terms of relative percentages of CWS when stratified by system size, source of water supply, and system ownership, based on previous data. Based on the findings it would seem that the overwhelming majority of Indiana CWS experienced little or no impact from the NIPDWR. About 38% can be said to have experienced a moderate impact on system operations due to the passage of the NIPDWR. Classifying Indiana CWS by size, source of water supply, and ownership was of limited value in predicting the actual degree of impact of a singular provision of the regulations on a particular community water system. The classification schemes were useful in identifying important differences in system characteristics. (Baker-FRC)
W82-05815

PHOSPHORUS INACTIVATION BY ZIRCONIUM IN A EUTROPHIC POND,
Corvallis Environmental Research Lab., OR.
W. D. Sanville, C. F. Powers, G. S. Schuytema, F. S. Stay, and W. L. Lauer.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 434-443, May, 1982. 8 Fig, 7 Tab, 25 Ref.

Descriptors: *Phosphorus removal, *Zirconium, *Algae, Water treatment, Nutrients, Eutrophied lakes, Fish, Ponds, Phytoplankton, Sediments, Biomass.

Zirconium tetrachloride at initial levels of 5 mg Zr per liter controlled phytoplankton production in a euthrophic farm pond without producing acute or long-term effects in plants and animals. The chemical was added to the experimental half of the pond on March, 26-27, 1974. The other half, separated by a vinyl curtain, was the control. During the first year after treatment the experimental side had lower total phosphorus and all measures of biomass than the control. By the end of July the control pond contained 200,000 cells per ml, and the experimental side, 30,000 cells per ml. There was no drastic changes in species diversity in the experimental pond after Zr treatment. Zr contents of pond plants and invertebrates were highly variable. Fish showed no bioaccumulation. Total Zr concentrations (in mg per liter) in pond water were 1.9 the day after application, 0.592 on April 25, 1974, and 0.010 or less thereafter. Leakage from the experimental side to the control side caused Zr levels in the control side to reach 0.2 mg per liter for the month after application. Concentrations of Zr (micrograms per g) in sediments on November 20, 1975, were 468, experimental; 193, control; and 65 in an adjacent pond and fields. (Cassar-FRC)
W82-05856

LIMING FISH PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. E. Boyd.
Journal of Soil and Water conservation, Vol 37, No 2, p 86-88, March/April, 1982. 2 Tab, 30 Ref.

Descriptors: *Ponds, *Lime, Acidic water, Water treatment, Fish ponds, Carbonates, Fish food organisms, Sediments, Water quality management, Acid soils, Alkalinity, Calcium carbonate, Aquaculture.

Fish production in ponds can often be improved by liming with agricultural limestone, calcium hydroxide, calcium oxide, basic slag, or liquid lime. Properly applied, these materials react with acidity to form bicarbonate which is then available as a carbon source to plants. In sediments liming increases the rates of organic matter decomposition and nutrients cycling. Other effects of liming on ponds are reduction of turbidity and increase in production of fish food organisms. A table of lime requirements for pond muds of different pH and texture is given. Mud of pH < 4.0 requires 12,800 pounds per acre of $CaCO3$ in heavy loams or clays, 6,400 pounds per acre in sandy loams, and 4,000 pounds per acre in sand. Lime requirements drop to 1600, 1600, and zero, respectively, at pH 6.1-6.5. Ponds above pH 6.5 need not be limed. Application methods include liming the bottom with conventional spreader before filling, spreading from a boat or raft or platform between boats, and pumping slurries or blowing dust from a truck on the shore. The boats, and pumping slurries or blowing dust from a truck on the shore. The effects of lime treatment last 2-4 years if the water exchange rate is low. Highly acid ponds (below 4.5) usually received drainage from acid sulfate soils. For liming to be effective the source of acid must be treated or removed. (Cassar-FRC)
W82-05866

FUTURE WATER DEVELOPMENT POLICIES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe, and G. E. Radosevich.
Water Supply and Management, Vol 6, No 1-2, p 221-232, 1982. 11 Ref.

Descriptors: *Salinity, *Colorado River, *Irrigation efficiency, *Water resources development, *Water policy, *River basin development, Desalination, Irrigation canals, Canal linings, Resources development, Water law, Water demand, Water management, Irrigation practices, River basins, Irrigation-return flow.

Energy resources are being increasingly developed in the Upper Colorado River Basin, with the consequences of further deterioration of the waters reaching the Lower Colorado Basin, especially in the form of added salinity. The basin-wide, nondegradation salinity policy for the lower stem of the river mandates that each development offset salinity contributions by making on-site improvements or off-site alterations somewhere else in the river basin. One practical off-site modification involves providing irrigation canal linings and on-farm improvements in irrigation efficiency. Such projects decrease irrigation diversion requirements while increasing agricultural productivity. with changes in western water laws, economic incentives and administrative programs could be devised to allow the contract sale or rent of decreased diversion requirements to other water demands; resulting revenues could be used to improve irrigation systems to further reduce salt loading to the Colorado River. (Geiger-FRC)
W82-05884

THE COLORADO RIVER SALINITY PROBLEM,
Environmental Protection Agency, Ada, OK. Robert S. Kerr Environmental Research Lab.
J. P. Law, Jr., and A. G. Hornsby.
Water Supply and Management, Vol 6, No 1-2, p 87-104, 1982. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Water quality control, *Salinity, *Colorado River, *Environmental effects, *Resources development, *Irrigation practices, River basins, River basin development, Water resources development, Resources management, Water demand, Irrigation water, Water management.

In the Upper Basin of the Colorado River, 52% of the salt loading comes from irrigated agriculture, 9% from natural point sources, and only 2% from municipal and industrial uses. Damage from salt loading occurs mostly in the Lower Colorado River Basin. Remedies for salinity problems include collecting and treating or disposal of natural point sources. Cost-effective technologies for dealing with salt loadings due to irrigated agriculture include improved irrigation and on-farm management practices to reduce deep percoaltion loss and the building of canals and laterals to channel salt losses. Development of coal and oil shale resources in the Upper Colorado River Basin will necessitate use of river water, allowing even less downstream flow for salt dilution. Future water resource developments will require more stringent salinity control and management decisions based on scientific reasoning rathe than political motivations. (Geiger-FRC)
W82-05889

INTERNATIONAL PROBLEMS ON THE COLORADO RIVER,
Colorado River Board of California, Los Angeles.
M. B. Holburt.
Water Supply and Management, Vol 6, No 1-2, p 105-114, 1982. 1 Tab.

Descriptors: *Water quality control, *Salinity, *Colorado River, *International agreements, *Irrigation effects, River basins, Water policy, Water management, Groundwater availability, Water resources development, Desalination.

The Colorado River provides irrigation water to nearly 500,000 acres of land in the Republic of Mexico and serves over 500,000 people in that country. In 1961, the discharge of highly saline pumped drainage from the Wellton-Mohawk Irrigation and Drainage District surrounding Yuma, Arizona, significantly increased the salinity of the Colorado River waters reaching Mexico. In 1973, a Water Treaty was signed, establishing definite limits to the salinity levels that would be allowed in the Colorado River was delivered to Mexico upstream from the Morelas Dam in relation to the water at Imperiam Dam. Although this treaty was intended as a permanent solution to the salinity problem, new arguments could arise with Mexico if the operation of the Unuma Desalting Plant fails to reach the standards which were agreed upon. The pumping of groundwater by Mexico that induces groundwater flow from the United States to Mexico may also develop into a controversial issue. New water resources developments in the United States may require the implementation of additional salinity control measures in the near future. (Geiger-FRC)
W82-05892

OPTIMAL SALINITY CONTROL PROGRAM FOR THE UPPER COLORADO RIVER BASIN,
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 169-197, 1982. 14 Fig, 7 Tab, 13 Ref.

Descriptors: *Model studies, *Optimum development plans, *Desalination, *Cost analysis, *Colora-

do River, Salinity, Optimization, Irrigation efficiency, Planning, Irrigation effects, River basin development, Water resources development, Irrigation-return flows.

A simple multi-level nonlinear optimization model was used to derive the most cost-effective strategies for salinity control in the waters of the Upper Colorado River Basin. The methodology gives qualitative data on the location and general types of alternatives that would be useful in a least cost basin-wide salinity control program and the expected salt load reduction and annual costs of each preselected level of control. Conditions from January 1980 were used to estimate the costs and salinity contributions associated with various control alternatives. Cost effectiveness functions were formulated for each major irrigation canal and laterals, aggregate laterals under each canal, and on-farm improvements for each agricultural project area. Similar functions were developed for such point sources as Paradox Valley, Glenwood-Dotsero Springs and Crystal Geyser. The desalination of agricultural return flows was also evaluated. The optimal salinity control program in the Upper Colorado river Basin would cost about $30 million annually for 1.2 million metric tons of salt removal. Sensitivity analysis of the optimization procedure showed that substantial error in costs and the respective salt load contributions of the individual alternatives would have to occur to alter the optimal order of implementation of a basin-wide salinity control program. (Geiger-FRC)
W82-05893

SALINITY CONTROL MEASURES FOR GRAND VALLEY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F.
W82-05894

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER REUSE PLANNING BY MEANS OF AN INPUT-OUTPUT TABLE,
Swiss Reinsurance Co., Zurich.
D. Klooz, and D. W. Hendricks.
Journal of the American Water Works Association, Vol 74, No 1, p 51-56, 1982. 7 Fig, 3 Tab, 3 Ref.

Descriptors: Planning, *Water reuse, *Colorado, *Cache La Poudre River Basin, Data analysis, *Project planning, Agricultural water use, Industrial water, Water storage, *Input-output analysis, Water demand, Water use, Future planning, Used water.

An input-output table analysis suitable for application in water reuse planning was developed and applied to the Cache La Poudre River basin in Colorado. Analysis is facilitated by the ability of the input-output table to organize and collate large amounts of complex data both structurally and operationally. Aggregated input-output tables were developed for proposals for new projects construction and intensified reuse for the year 2020. The tables failitate comparison of the uses of virgin water and used water between the two solutions. Reused water is shown to represent a feasibile means for meeting projected demands. The reuse factor, defined as the total water use divided by the total amount of virgin water supply, increases from 1.34 to 1.46 upon implementation of intensified reuse. Used water is prominent in satisfying industrial and agricultural water demands under the intensified reuse solution. Unplanned reuse maintains its important place in both solutions. Basin outflow is reduced by intensified reuse. The amount of water saved by intensified reuse is only about 8%, but this could spare the need for expensive new storage projects. This clearly organized evaluation format aids in assessing proposed projects for their ability to satisfy new water demands and in examining their positive and negative interactions on the rest of the system. (Carroll-FRC)
W82-04794

AN EVALUATION OF THE URBAN DESIGN STORM CONCEPT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
H. G. Wenzel, Jr., and M. L. Voorhees.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220666, Price codes: A08 in paper copy, A01 in microfiche. Research Report No 164, 147 p, 43 Fig, 19 Tab, 25 Ref, 8 Append. OWRT-A-095-ILL(2). 14-31-0001-6073.

Descriptors: *Design storms, *Simulation model, *Storm sewers, *Urban drainage, *Urban runoff, Design-hydraulics, Frequency analysis, Sewer systems, Simulation analyses, Storm drainage, Design flow.

This report describes an evaluation of the assumption commonly employed in drainage design that the return period of the rainfall used to design a system is the same as the peak flow produced by that rainfall. Specifically, the sensitivity of the frequency response of four catchments to design storm parameters is examined. Parameters include, hyetograph shape, antecedent soil moisture and rainfall duration. A continuous simulation model is used to compute simulated historical frequency responses for three different long term rainfall records.. Design storms also developed from depth-duration-frequency analyses of the rainfall data. Comparisons are made on frequency graphs. It is concluded that an appropriate choice of design storm parameters can produce a design which yields peak flows of the desired return period.
W82-04960

A SCREENING MODEL TO QUANTIFY RESILIENCE,
Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 27-32, February, 1982. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Planning, Resiliency, Costs, Economic evaluation, Systems analysis, Water supply, Optimization, *Project planning, Design criteria, Reservoirs, *Model studies.

The concept of resilience, used in statistics and biology, is applied to water resource systems. A resilient water supply system does not respond precipitously to a major surprise or perturbation during the course of its economic life. For example, a well-designed water system is relatively insensitive (or resilient) to an event such as the Northeast Drought of 1961-65. Neglecting this resilience factor in planning an optimum design may produce a system which is cost-effective but intolerant of perturbations. A screening model is presented for 8 reservoirs of different size operating in parallel. Results imply that large systems which are not markedly over- or understressed can adapt to a range of potential capital investments without seriously compromising performance characteristics. For understressed systems the most resilient design used 2 or 3 reservoirs; for overstressed systems, more than 6; and for the intermmediate cases, 4. Another measure of system resilience is based on adaptability of a single design to changes in target. A fully resilient system can deliver all intermediate targets at the same performance level. Mean resilience peaks at systems slightly smaller than maximal. Further increases in size produce small reductions in mean resilience and greatly reduce variance (resilience). A tradeoff between the mean and standard deviation of resilience can help attain the optimum system size. (Cassar-FRC)
W82-05044

ALTERNATIVE INDICES OF RESILIENCE,
Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 33-39, February, 1982. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Planning, *Resilience, Economic evaluation, *Systems analysis, *Project planning.

The concept of resilience, previously introduced into ecology literature, may be useful in the application of systems analysis to water resources planning. Various ideas regarding resilience deal with recovery of water resource systems and minimization of surprises. Several mathematical definitions for resilience of water resource systems are outlined, and the advantages and disadvantages of these definitions compared. No single definition is designated as the best. All are based on the time required to pass from one system state to another. The passage to or from a given state is defined as failure. Some of the definitions involve probability of recovery from failure to an acceptable state within a specified time interval. (Cassar-FRC)
W82-05045

ESTIMATES OF RESILIENCE INDICES BY SIMULATION,
Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 41-50, February, 1982. 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Reservoirs, *Design criteria, Planning, *Water resources development, *Model studies, Mathematical studies, *Resilience, Alternative planning, Reservoirs.

A simulation study was performed to define and assess the basin property of resilience. Testing was carried out on a few speculative definitions developed for this property. The purpose of the analysis was to develop some insights into the resilience of the system in the vicinity of its global or local cost optima. Resilience indices were calculated according to some of the previously published formulas for several reservoir configurations which constitute a set of sample plans for a river basin. Basin characteristics are introduced to estimate proposed surrogates of system resilience without the necessity of performing long and expensive simulation studies. These simulations are necessary to develop resilience indices for the sample basins and to compare them to a few conventional ranking functions. The objective of this procedure was to determine if conventional indices replicate information contained in resilience indices and the extent to which either or both of these can be estimated from basin geometry. Consideration is given to combinatorial analysis, system operating policy, generalization to six reservoir storages, and an index for estimating system performance. The results, although imperfect, are encouraging and suggest areas for continuing work in the mapping of basin characteristics and configuration into performance indices. (Carroll-FRC)
W82-05046

ESTIMATING RESILIENCE BY CANONICAL ANALYSIS,
Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 51-57, February, 1982. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Planning, *Reservoirs, *Mathematical studies, Design criteria, *Model studies, Operating criteria, *Water resources development, *Resilience, Alternative planning.

In a previous study, mutivariate or cluster analyses were proposed to define the basin properties and storage surrogates which, alone or in combination, could be used to form a tight estimator of system performance. Canonical correlation was suggested as especially suitable for predicting system resilience and some conventional performance indices without expensive simulation, and thus 'backing into' an operational definition of resilience. Canonical correlation analysis is used to formulate linear estimates of independent or orthogonal (incremental) information on the performance of water resource systems. Simple economic and resilience indicators are compared, and for the particular configurations selected the replicated and inde-

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pendent information sets are explained in terms of the connectivity of the various reservoirs. The canonical correlations obtained are relatively high, suggesting that there is a significant replication of information. A taxonomy is developed which suggests the basin and structural characteristics which would show less replication and permit improved description of system performance. (Carroll-FRC)
W82-05047

USE OF MATHEMATICAL MODELS TO GENERATE ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. Y. Chang, E. D. Brill, Jr., and L. D. Hopkins.
Water Resources Research, Vol 18, No 1, p 58-64, February, 1982. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Alternative planning, *Optimization, *Model studies, Mathematical models, Wastewater treatment, *Water resources development, *Wastewater facilities.

Alternatives for water resources planning problems were generated by three optimization models, the Hop. Skip, and Jump method (HSJ), a random method, and a branch and bound/screening method (BBS). The sample problem was to find the best arrangement for a wastewater treatment system with 15 wastewater sources, 12 possible plant sites, and 15 potential interceptor levels. The sets of alternatives generated by all 3 methods were different from each other. For each method the alternatives were different in different ways. The HSJ method generated alternatives differing in number of plants, i.e., degree of centralization. The random method produced alternatives with similar numbers of plants and interceptors but with facilities in different locations. The BBS method generated alternatives in which part of the wastewater system was constant but combined with other arrangements of the rest of the system. The wide range of alternatives offers possibilities for creative solutions and consideration of political, social, and environmental aspects by the evaluators. All methods were efficient, suggesting that in practice it might be desirable to use all 3 for formulating alternatives. (Cassar-FRC)
W82-05072

ROBUSTNESS OF WATER RESOURCES SYSTEMS,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
T. Hashimoto, D. P. Loucks, and J. R. Stedinger.
Water Resources Research, Vol 18, No 1, p 21-26, February, 1982. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Performance evaluation, *Economic evaluation, *Water resources development, Design criteria, Robustness, Planning, Alternative planning, Costs, *Skane, *Sweden, Systems analysis, Water supply, Optimization, Risks, Project planning, *Cost analysis.

Robustness describes the overall economic performance of a water resource project. It measures the likelihood that the actual costs of a project will not exceed some fraction of the minimum possible cost of a system designed for the actual conditions that occur in the future. A water supply system planning problem in Skane, Sweden, was used as an illustration of the method. A large-scale interbasin transfer was proposed to meet uncertain future demands. Four design alternatives were evaluated for ability to meet demand in the year 2000. The value of robustness was calculated for each alternative. One of the four possibilities was clearly more robust than the other three, giving only a 2% probability of relatively very poor cost performance. (Cassar-FRC)
W82-05077

RELIABILITY, RESILIENCY, AND VULNERABILITY CRITERIA FOR WATER RESOURCE SYSTEM PERFORMANCE EVALUATION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
T. Hashimoto, J. R. Stedinger, and D. P. Loucks.
Water Resources Research, Vol 18, No 1, p 14-20, February, 1982. 9 Fig, 2 Tab, 26 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Reliability, Resiliency, Vulnerability, Dam failure, *Reservoirs, Operating policies, Systems analysis, Reservoir releases, Water supply, Planning.

Three performance criteria for evaluating water resource systems are proposed as additions to the commonly used mean and variance of benefits, pollutant concentrations, and operating variables. These are reliability (how likely a system is to fail), resiliency (how quickly it recovers from failure), and vulnerability (how severe are the consequences of failure). The three criteria are expecially important during periods of drought, peak demand, or extreme weather. As an example, they are used to evaluate the performance of a water supply reservoir under a winter operating policy of a specified released with storage of the excess. Alternative summer policies are standard (meet as much demand as possible), hedging (providing a portion of the target release), and one in which the entire target is met if possible, but in case of unavoidable modest failure no water is released. In this system high reliability is accompanied by high vulnerability. Although the optimum situation is maximum reliability and minimum vulnerability, this is impossible in practice. Tradeoffs can produce a high reliability, modest resiliency, and low vulnerability. (Cassar-FRC)
W82-05078

MODELLING AND CONTROL OF DISSOLVED OXYGEN IN AN ESTUARY,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Electrical Engineering.
B. J. Olufeagba, and R. H. Flake.
Ecological Modelling, Vol 14, No 1, p 79-94, 1981. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Dissolved oxygen, *Estuarine environment, *Mathematical models, Nitrification, Water pollution control, Bays, Prediction, Biochemical oxygen demand, Algorithms, Water quality management, Management planning, *Jamaica Bay, *New York.

Jamaica Bay, New York, is a highly polluted estuary which suffers from reduced dissolved oxygen concentrations due to the biochemical oxygen demand (BOD) of organic materials discharged by waste sources. The two-dimensional spatial distribution of dissolved oxygen in Jamaica Bay is approximated by a vector multipoint boundary value problem. This problem, which includes interactions involving the carbonaceous BOD and the total unoxidized nitrogen, is solved by a multiple shooting technique. This shooting algorithm requires less computer storage than its finite difference counterpart, realizes higher order accuracy easily, and requires the solution of a relatively small matrix. These results are then used in a variational sensitivity model, which is used together with the Goldfarb method for constrained nonlinear programming to determine optimal management policies. The performance index in each case is the capital cost of nitrification treatment at each of the polluting sources discharging into the bay. The model is used to determine the optimal economic nitrification treatment levels required to achieve a minimum dissolved oxygen concentration level of 5 milligrams per liter throughout the bay. The use of this model for the evaluation and choice of management alternatives in water quality planning is demonstrated. (Carroll-FRC)
W82-05188

ENERGY SITING IN UTAH: A PROGRAMMING MODEL,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6B.
W82-05297

SEASONAL RISK-BASED RESERVOIR OPERATING RULES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05299

RANDOM DIFFERENTIAL EQUATIONS IN RIVER WATER QUALITY MODELING,
Humboldt State Univ., Arcata, Dept. of Engineering.
B. A. Finney, D. S. Bowler, and M. P. Windham.
Water Resources Research, Vol 18, No 1, p 122-134, February, 1982. 11 Fig, 8 Tab, 31 Ref.

Descriptors: *Water quality, *Rivers, *Stochastic processes, *Model studies, Biological oxygen demand, Dissolved oxygen, Probablistic process, *Fate of pollutents.

A random differential equation model, a development from steady state probabilistic river water quality models, compensates for uncertainties such as natural variability and uncertainties in measurement--unrepresentativeness, errors, and incompleteness. The model is not limited by Monte Carlo, first-order analysis, or estimation theory techniques. Equations describing the water quality system are transformed from deterministic to random differential equations. Solution of these equations allows prediction of the joint probability density function of the water quality constituents at any location in the river system. Point loads and diversions may be handled. The model was applied to a sensitivity problem and to determination of BOD and dissolved oxygen in a hypothetical river system. Representing the randomness in water quality equations inputs and coefficients as a Gaussian white noise process is convenient. Randomness in water quality coefficient equations has greater influence on prediction concentrations than randomness in equation inputs. It is advantageous to approximate the marginal probability distribution function of BOD and dissolved oxygen with a normal distribution. This model may be useful in design of river water quality monitoring systems, implementation of reliability based on stream standards, and quantification of variability of constituent concentration for mangement, planning, and control purposes. (Cassar-FRC)
W82-05343

OPERATIONAL RESEARCH TECHNIQUES IN RIVER BASIN MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel.
Canadian Water Resources Journal, Vol 6, No 4, p 205-226, 1981. 1 Fig, 2 Tab, 51 Ref.

Descriptors: *Decision making, *Operations research, *Water management, *River basins, Conflict analysis, Fuzzy set theory, Model studies, Social aspects, Multipurpose projects, Poplar River, *Saskatchewan, Fort Peck, Montana, Stability analysis, Water resources development, Systems analysis, Canada.

Operations research methods for use in river basins management are described. The quantitative methods, divided into deterministic and probabilistic categories, have been widely applied to management problems. Nonquantitative methods, including the fuzzy set theory combined with multicriteria modelling, are especially valuable in evaluating intangible factors such as social and cultural effects of a water project. A conflict analysis methodology, the improved metagame analysis algorithm, is applied to the conflict in the Poplar River Basin (Saskatchewan-Montana). The three conflicting players are the Saskatchewan Power Company's thermal generating station, completed in 1979; Fort Peck Indians' irrigation water; and the International Joint Commissions's interests. Options are the possible activities of the players, such as power plant or irrigation projects of different sizes. Of the 4048 possible outcomes in this situation, only 22 are feasible. These are arranged in order of preference for each party. Each feasible outcome is then subjected to stability analysis by the improved metagame method, and equilibria (three in this study) established to indicate options most satisfactory to all parties. (Cassar-FRC)
W82-05387

A FEDERAL PERSPECTIVE ON RIVER BASIN MANAGEMENT,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 6E.
W82-05388

PROMISING STEPS TOWARD A NEW OTTAWA RIVER REGULATION,
For primary bibliographic entry see Field 6E.
W82-05394

NEW STRATEGIES FOR WATER RESOURCE PLANNING IN BRITISH COLUMBIA,
Department of the Environment, Victoria (British Columbia).
For primary bibliographic entry see Field 6E.
W82-05395

COLD LAKE-BEAVER RIVER REGIONAL WATER RESOURCES STUDY,
Department of the Environment (Edmonton).
For primary bibliographic entry see Field 6D.
W82-05396

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,
S. Morariu.
International Water Power and Dam Construction, Vol 33, No 12, p 52-55, December, 1981. 2 Fig, 2 Tab.

Descriptors: *Computer programs, *Hydroelectric power, Predictions, Hydrologic data, Hydroelectric powerplants, Peru, Water resources development, Future planning.

A master plan has been prepared for the development of Peru's hydroelectric potential. As a first step in this process, data on the hydrological characteristics of Peru were collected from limited published sources, including Landsat data and radar photographs, and backed up by field surveys. A unified, computerized hydrological data bank for Peru is now in existence. A computerized model of 111 river basin models was used to calculate the mean discharge and theoretical hydro potential and to define 81,355 kilometers of hydrographic networks. The theoretical mean linear hydropower potential for Peru was found to be about 206,107 megawatts, most of which is concentrated on the eastern side of the Andes. About 25 to 50% of this quantity could be developed within existing technical and economic constraints. Potential projects were identified on the basis of available topographical, geological, and hydrological information and then inspected to evaluate technical feasibility. Basic designs were developed for all projects considered to be technically feasible. General cost curves were applied to each project and project variation for the estimation of capital expenditures attributable to each project element. Potential hydroelectric projects were then compared on the basis of calculated unit cost per kilowatt hour of energy produced. A preliminary screening process was conducted to identify optimal development chains on the basis of the minimum weighted cost of energy production. Potential projects were then ranked according to a number of technical/economic criteria and classified with respect to a range of installed capacities and availability of basic information. Visits to over 800 sites resulted in assessment of 560 projects in 2,300 different configurations. (Carroll-FRC)
W82-05515

APPLICATIONS OF SIMULATION TO SPECIFIC WATER PROJECTS,
Bochum Univ. (Germany, F.R.). Dept. of Water Sciences and Environmental Technology.
R. Harboe, and G. A. Schultz.
Journal of Hydrology, Vol 51, No 1-4, p 131-138, May, 1981. 6 Fig, 10 Ref.

Descriptors: *Simulation analysis, *Water supply development, *Water use, Water pollution, Irrigation, Environmental effects, Mathematical models, Water management, Computer programs.

Digital computer simulation involves the reproduction of the real system's static and dynamic characteristics through a mathematical model which is translated into a computer program. In only a few minutes this model can then reproduce the behavior of the system over long periods of time, allowing the decision-maker to analyze several alternatives rapidly. In water resources systems, computer simulations may be used to examine such alternatives as different sizes of reservoirs, power plants, and irrigation areas; several operation policy options; and hydrological records and various constraints due to water quality, navigation, recreation, and/or environmental protection. Four examples of applications of simulation analysis are discussed. These include simulations for a hydroelectric power system in Central Europe, for an irrigation system in South America, for a water supply reservoir system including environmental requirements in Germany. The examples include discussion of inputs used for each of the simulations, analysis goals, and performance of the simulation. The examples demonstrate the flexibility of the simulation technique. The technique is not too difficult to apply in practice and can be used to find optimum solutions for both design and operation of water resources systems. (Carroll-FRC)
W82-05522

THE ROLE OF UNCONDITIONED AND CONDITIONED CUMULATIVE DISTRIBUTION FUNCTIONS IN RESERVOIR RELIABILITY PROGRAMMING,
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
S. P. Simonovic, and M. A. Marino.
Journal of Hydrology, Vol 52, No 3/4, p 219-228, July, 1981. 5 Tab, 14 Ref.

Descriptors: *Reservoir operation, *Mathematical studies, *Computer models, Reservoir releases, Reservoir design, Stochastic process, Mathematical models.

Mathematical models based on the relliability programming technique have been developed for solving stochastic problems of reservoir design and/or operation. The results obtained from the reliability program of a reservoir management problem based on the use of unconditioned cumulative distribution functions are compared with those obtained when conditioned cumulative distribution functions are used. The reliability program considers the reservoir releases and the reliabilities of the elements of the reservoir system as decision variables. Data from the Vardar River system in Yugoslavia are fitted with Pearson Type-III distributions for the case of unconditioned cumulative distribution functions and with bivariate gamma distributions for the case of conditioned cumulative distribution functions. Objective-function values and reliability tolerances obtained when conditioned cumulative distribution functions were used in the reliability program were greater than those obtained using unconditioned cumulative distribution functions. Although the study results cannot be generalized to other reservoir management problems, the use of conditioned cumulative distribution functions will give more realistic results than the use of unconditioned cumulative distribution functions in cases in which streamflow data are known to be stochastically dependent. It is concluded that the use of conditioned cumulative distribution functions represents a step forward in overcoming the conservative nature of stochastic models used for the design and/or operation of multipurpose multiple reservoir systems. (Carroll-FRC)
W82-05523

DISCRETIZATION IN STOCHASTIC RESERVOIR THEORY WITH MARKOVIAN INFLOWS,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
R. M. Phatarfod, and R. Srikanthan.
Journal of Hydrology, Vol 52, No 3/4, p 199-218, July, 1981. 9 Tab, 8 Ref.

Descriptors: *Stochastic process, *Mathematical models, *Reservoirs, Mathematical equations, Markov process, Numerical analysis.

The twin problems of the nature of discretization and the size of the unit of discretization used in stochastic reservoir theory are examined. The feasibility of constructing a discretization sheme which allows the relese and the reservoir size to assume fractional values is demonstrated. The case where the inflows form a sequence of seasonal Markov dependent variables is then considered. A discretization scheme is suggested which gives better estimates of the probabilities of emptiness and fullness of the reservoir than those provided by the scheme developed by Dearlove and Harris. A numerical comparison of these probabilities with those obtained by simulation is made for the case where the inflows follow a Thomas-Fiering model. Finally, the effect of the size of the unit of water on these probabilities is disussed briefly. (Carroll-FRC)
W82-05524

MULTIPLE OBJECTIVE PLANNING OF LAND/WATER INTERFACE IN MEDIUM SIZE CITIES: APPLICATION TO WEST LAFAYETTE, INDIANA,
Purdue Univ., Lafayette, Ind. Water Resources Research Center.
For primary bibliographic entry see Field 4A.
W82-05550

OPTIMALITY, INFORMATION GENERATION STRATEGIES, AND WATER RESOURCES MANAGEMENT IN THE YUKON TERRITORY,
British Columbia Univ., Vancouver. Westwater Research Center.
I. K. Fox.
Canadian Water Resources Journal, Vol 5, No 3, p 56-68, 1980. 1 Fig, 3 Tab.

Descriptors: *Water management, *Project planning, *Research priorities, Planning, Yukon Territory, Public participation, Westwater Project, Electric power, River basins, Optimization.

The planning method used in the Westwater Research Center's Yukon Water Research Program (University of British Columbia) is described. Basic steps are as follows: (1) determine the range of preferences through interviews with persons representing many interest groups, (2) establish investigation priorities during a 3-day professional workshop divided into four groups (electric power, mining, fish and wildlife, and recreation-tourism), (3) undertake the high priority investigations, (4) assess the study results at a second workshop, and (5) prepare reports. Two suggestions are emphasized: (1) the public should be included in establishing investigation priorities, and (2) yearly review and reporting produces results more sensitive to changes in economic, social, and environmental conditions than final reports after several years' study. (Cassar-FRC)
W82-05564

EVOLUTION OF WATER MANAGEMENT TECHNIQUES,
British Columbia Univ., Vancouver. Dept. of Civil Engineerig.
S. O. Russell.
Canadian Water Resources Journal, Vol 5, No 3, p 49-55, 1980. 3 Ref.

Descriptors: *Decision making, *Water management, *Computers, Simulation analysis, Hydrologic data collections, Data collections.

Computers have aided the evolution of water management techniques during the last 20 years. Storage and manipulation of hydrologic data and simulation analysis of runoff and floods are widely and successfully used in decision making. However, human judgment has not been eliminated, only used at a different level and time. Examples of simulation analysis are forecasting levels in Lake Athabasca if the Peace River Project is built and optimizing design of water distribution networks. Although problems involvig uncertainty and multiple objectives are still difficult to handle, the trend is toward more objective and automatic techniques and less judgment and intuition. (Cassar-FRC)
W82-05565

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MODIFIED STANDARD OPERATION RULES FOR RESERVOIRS,
Technische Hochschule, Aachen (Germany, F.R.). Hydropower Div.
For primary bibliographic entry see Field 4A.
W82-05658

AN APPLICATION OF MATHEMATICAL PROGRAMMING TO WATER RESOURCES PLANNING: AN ECONOMIC VIEW,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
B. E. Lindsay, and D. L. Dunn.
Water Resources Bulletin, Vol 18, No 2, p 289-296, April, 1982. 6 Tab, 4 Ref.

Descriptors: *Optimization, *Water resources development, Systems analysis, *Regional planning, Planning, Water use, Water demand, Water supply, Municipal water, Mathematical models, Model studies, Merrimack River, New Hampshire, Costs, Water distribution.

A mixed integer multiperiod programming model using hydrologic and economic data was used to identify the discounted least cost of water supply, distribution, and scheduling for three New Hampshire towns, Hudson, Merrimack, and Nashua. The model was applied on an individual town basis and on a regional basis. Costs of regionalized water resources development ($2.8-4.3 million) were about 5-10% less than costs of deregionalized schemes for the three towns ($3-4.5 million) for present water usage, 20% more water usage, and 10% less water usage. (Cassar-FRC)
W82-05737

FLOOD DAMAGE ASSESSMENT AND FLOOD CONTROL PLANNING AS PART AND PARCEL OF THE ECONOMICS OF WATER UTILIZATION (VLOEDSKADEBEPALING EN VLOEDSKADEBEHEER AS ONDERDELE VAN DIE EKONOMIE VAN WATERBENUTTING),
Orange Free State Univ., Bloemfontein (South Africa).
M. F. Viljoen, and D. J. G. Smith.
Water S. A., Vol 8, No 1, p 45-51, January, 1982. 9 Fig, 12 Ref. English abstract.

Descriptors: *Economic aspects, *Flood control, Floods, Flood damage, Flood protection, Cost-benefit analysis, Cost analysis, Water use, Planning.

In the field of the economics of water utilization, flood damage assessment and flood control planning play integral parts. National welfare is increased by rational use of national resources, including water. Welfare economics supplies the theoretical framework for use in the planning of water utilization. The cost-benefit technique is generally accepted as the application of welfare economics, but it is necessary to consider that this technique only focuses on economic efficiency within a partial equilibrium framework. The traditional application of the technique does not supply the final answer for the maximization of welfare. For completeness, this method should be supplemented with the evaluation of other welfare objectives such as environmental quality, distribution of income and security. In planning for control of flood damage, the minimization of flood damage represents the greatest part of the benefits to be obtained, and thus it comprises one of the important components in cost benefit analysis. Other benefits embodied in welfare objectives are frequently hard to measure, and the best alternative seems to be an optimal understanding of these, quantitatively and qualitatively. When weighing the intangibles against the tangibles, value judgments will necessarily have a role to play. (Baker-FRC)
W82-05896

6B. Evaluation Process

APPARATUS NEEDS AND COSTS FOR MONITORING PRIORITY POLLUTANTS,
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5A.
W82-04779

COMPETITION FOR WATER RESOURCES: COAL AND AGRICULTURE IN THE YELLOWSTONE BASIN,
Indiana Univ. at Bloomington.
For primary bibliographic entry see Field 6D.
W82-04805

ANAEROBIC TREATMENT OF HIGH-STRENGTH WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-04907

GROUND-WATER DEVELOPMENT IN WESTERN RIVER BASINS: LARGE ECONOMIC GAINS WITH UNSEEN COSTS,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4B.
W82-04932

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,
S. Morariu.
International Water Power and Dam Construction, Vol 34, No 1 p 34-39, January, 1982.

Descriptors: *Hydroelectric plants, *Evaluation, Computers, Testing procedures, Hydrology, Geology, *Turbines, Flow profiles, Hydraulics, Water demand, *Peru.

The kind of data and the assessment of the data employed in a computer aided study of Peru's hydropower situation are presented. Both geologic and hydrologic parameters were included in the study. The overall objective of the hydrology studies was the analysis of all available data and the identification of regional patterns and trends. The hydrological parameter of overriding importance was the flow available for the turbines. Design floods were estimated through regional analysis. A regional drought analysis was also carried out, based on the need to determine the firm capacity of the independent projects and the guaranteed power and energy of the interconnected system. A very large number of hydropower projects was evaluated using a computer based method which allowed a systematic evaluation of the hydropower resources of the country to be made. With over 2300 hydropower project options, it was possible to analyze 1.6 x 10 to the 13th power river development chains. As a result of the optimization model used, 328 project variations emerged as being compatible, with a total installed capacity of over 58,000 MW. It is suggested that a proper and systematic evaluation of the world's hydropower be made using the same or similar computer aided methodologies to minimize the time and manpower requirements without sacrificing accuracy. (Baker-FRC)
W82-04954

INSTITUTIONAL OBSTACLES TO WATER REUSE IN THE WESTERN UNITED STATES,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
K. Wehbring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220641, Price codes: A09 in paper copy, A01 in microfiche. OWRT/RU-80/8, 1981, 195 p, 7 Fig, 3 Tab. OWRT C-80215-R(1). 14-34-0001-8819.

Descriptors: *Water reuse, *Institutional constraints, *Legal aspects, *Political aspects, Local governments, Water law, Water rights, Economic aspects, Financing, Public health, Wastewater treatment, Planning, City planning, *Western United States, California, Arizona, Nevada, Colorado, New Mexico.

The institutional barriers were examined to reusing wastewater in nine communities in the Western United States. Institutional barriers include legal, political, financial and organizational problems which hinder the development of water reuse projects. Case studies were prepared for the following communities: Santa Clara Valley Water District, Goleta County Water District, Los Angeles, Las Virgenes, and Solano County in California; Tucson, Arizona; Las Vegas, Nevada; Northglenn, Colorado; and Santa Fe, New Mexico. The study identifies obstacles and suggests ways of overcoming the obstacles. They are 1) Competing uses for water; 2) EPA grant requirements; 3) Health regulations; 4) Financing methods; 5) Neighborhood opposition to treatment facility site; 6) Urban growth issues; 7) Inter-agency conflict. The main approach recommended for overcoming these obstacles is to carry out institutional planning as a part of the overall planning for a water reuse project so that obstacles can be defined and alternative methods of overcoming them devised.
W82-04958

THE 1977 DROUGHT IN IDAHO: ECONOMIC IMPACTS AND THE RESPONSES OF IRRIGATORS AND WATER DELIVERY ORGANIZATIONS.
Idaho water and Energy Resources Research Inst., Moscow.
For primary bibliographic entry see Field 3F.
W82-04959

HYDROGEOLOGY FOR LAND-USE PLANNING: THE POTTER CREEK AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 5G.
W82-04981

WATER AND WASTEWATER MANAGERS FACE THE FINANCIALLY TROUBLED 1980S,
Graham Associates, Inc., Dallas, TX.
F. G. Honeycutt, Jr., and W. B. London.
Water/Engineering and Management, Vol 129, No 2, p 24-26, February, 1982. 2 Tab.

Descriptors: *Economic aspects, *Water management, Planning, Wastewater treatment, Feasibility studies, Municipal wastewater, *Wastewater management, Future planning.

Many water managers believe that financing will be the major problem facing the water industry in the current decade. The water industry is striving to meet this problem through reassessments of its management and financial practices in an effort to become self-reliant in performing the needed capital improvements. In the preparation of budget controls and financing alternatives for capital improvement programs, some of the major economic factors include current and projected inflation as well as municipal bond and prime interest rates. Inflation is the primary economic factor that continually plagues budgets and long term financial plans. Water and wastewater managers are especially aware of the effect of inflation on municipal bond and prime interest rates. However, in spite of the current hardships facing water and wastewater managers, innovative and creative capital improvements strategies are either currently available or are in the formulation stages. Several methods of direct state participation are currently in use throughout various parts of the country. A concept also exists whereby states guarantee principal and interest through the life of the municipal bonds issued by qualifying municipalities. States may also provide matching funds for certain types of water and sewer projects to their local units of government, particularly for planning purposes. A relatively new factor in the bond market is municipal bond insurance, which has some limited success in lowering borrowing costs for certain municipalities. (Baker-FRC)
W82-05166

WATER RESOURCES OF THE WALKER RIVER INDIAN RESERVATION, WEST-CENTRAL NEVADA,

Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $8.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-427, December 1980. 61 p, 18 Fig, 14 Tab, 25 Ref.

Descriptors: *Water resources development, *Available water, Groundwater, *Water use, Streamflow, Irrigation water, Wells, Groundwater recharge, Groundwater movement, Water level, Mathematical models, Potential water supply, Evaluation, Hydrologic data, *Nevada, *Walker River Indian Reservation, Surface water.

Increasing interest in expanding the livestock and agricultural operations on the Walker River Indian Reservation, Nev., has prompted the Walker River Paiute Tribe to have the present and available water resources of the reservation appraised and proposed sites for new wells evaluated. Flow of the Walker River into the reservation averages about 113,000 acre-feet a year. Of this amount, about 42,000 acre-feet is used on the reservation, recharging the gound-water system and supplying irrigation water for alfalfa and pasture crops. The water quality of the river water is well suited for these purposes, and the possibility of expanding surface-water use exists. A mathematical model of the ground-water system was constructed to test various assumptions about recharge and discharge rates. The model generated water-level contours that agreed reasonably well with measured water levels, median deviation was 12 feet. With additional data, the model could be used in the future to test the feasibility of evapotranspiration salvage at the seven proposed sites for new stock and irrigation wells. The primary users of ground water on the reservation are phreatophytes and playa surfaces. They allow ground water to be lost to evaporation. About 19,000 acre-feet per year is lost through this mechanism. Domestic and livestock uses account for only about 250 acre-feet per year. Total recharge to the ground-water system amounts to about 30,000 acre-feet per year, and the possibility of more extensive use of ground water on the reservation exists. Quality of the ground water in most areas is suitable for all intended purposes. (USGS)
W82-05235

WATER RESEARCH IN ACTION.
Texas A and M Univ., College Station. Water Resources Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224684, Price codes: A09 in paper copy, A01 in microfiche. Water Research in Action, Vols. 1-5, 1976-1981. Ruesink, L.E., ed. 172 p. OWRT C-80021-T(No 8703)(1).

Descriptors: *Research priorities, *Water resources institutes, *Literature review, *Research needs, *Water conservation, *Water quality control, Organizations, Water quality management, Reviews, Water quality, Water supply, Research facilities, Land use, Runoff, Water use, Water pollution, Water analysis, Technology, Water law, *Office of Water Research and Technology.

Five years (1976-81) of Water Research in Action bulletins are provided, covering Volumes 1-5. Each issue of the bulletin focuses on new knowledge and technology developed through the cooperative research program between the 54 state water resources research institutes and the Office of Water Research and Technology (OWRT), U.S. Department of the Interior. The bulletin is regularly distributed to over 22,000 individuals in all 50 states and a number of foreign countries. The early bulletin issues report on individual research projects from the institutes; the later issues present comprehensive overviews of specific water resources problems, and feature OWRT-funded institute-directed projects that have contributed to the solution of these problems. The numerous topic areas included address land use, flooding, runoff, wastewater, planning optimization, nonpoint source pollution, modeling, erosion, groundwater, water quality, irrigation, reservoirs, waste heat disposal, water sterilization, eutrophication, water conservation and reuse, water law, droughts, acid precipitation, economics, and management. (Zielinski-MAXIMA)
W82-05292

ENERGY SITING IN UTAH: A PROGRAMMING MODEL,
Utah Water Research Lab., Logan.
D. L. Snyder, J. E. Keith, T. F. Glover, and G. L. Wooldridge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224726, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-81/04, June 1981. 55 p, 6 Fig, 32 Tab, 78 Ref. 3 Append. OWRT A-047-UTAH(1), 14-34-0001-9047.

Descriptors: *Energy sources, *Regional development, *Model studies, *Linear programming, *Utah, Systems analysis, Mathematical models, Industrial development, Industrial plants, Electric power industry, Resources development, Industrial production, Resource allocation, Water allocation, Political constraints, Air pollution, Regulations, Legal aspects, Economic impact, Economic evaluation, Economic feasibility, Energy, Agriculture, Air pollution effects.

A study was conducted to examine the economically efficient allocation of resources between existing and proposed production entities, given resource and environmental constraints. The necessary conditions for an optimal input and output allocation were determined for a region constrained by resource availabilities and/or policy constraints, using a conceptual model of a multiple-product firm. A linear programming model was developed to determine optimal water allocation between agricultural and coal-fired power plants and the trade-offs which could occur if electrical generation were increased. Other potential trade-offs examined included coal source restrictions and air quality regulations. Also included were coal mining, transportation costs, and pollutant (S02, nitrogen oxides, particulates) emission rates on a coal and plant basis. Few trade-offs between power generation and agricultural irrigation were noted. However, substantial energy sector changes were discovered as coal capacities were decreased and air quality standards increased, causing a sharp decline in net revenues. Substantial changes in regional economic activity occurred due to these restrictions on development. (Zielinski-MAXIMA)
W82-05297

FIVE-YEAR PLAN FOR WATER RESEARCH OF THE OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE.
Oklahoma Water Resources Research Inst., Stillwater.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224767, Price codes: A03 in paper copy, A01 in microfiche. Oklahoma Five-Year Water Resources Research Plan, submitted to the Office of Water Research and Technology, December 1980. 39 p, 6 Fig, 10 Ref.

Descriptors: *Oklahoma, *Research priorities, *Planning, *Water management, *Water resources development, Rainfall distribution, Land rights, Water supply, Available water, Water shortage, Reservoir construction, Flooding, Groundwater depletion, Streamflow depletion, Municipal water, Industrial wastes, Water pollution, Mineralization, Acid mine drainage, Pollutants, *Five-year plan.

This report outlines the water resource quantity and quality problems of Oklahoma and identifies areas for research emphasis. While water quality problems warrent concern and action, water quantity in certain areas is an overriding current concern. Annual precipitation varies from 56 inches in the humid southeast to 15 inches in the semiarid Panhandle. Furthermore, evapotranspiration and percolation consume about 80% of the annual rainfall, leaving only about 20% available for use. Another major problem has been the lack of a water resources plan. Such a plan, addressing water needs through the year 2040, has now been developed and is under review. A third problem area is an on-going mineral rights dispute with the Osage Indians, causing interruption of construction on four reservoirs. Other identified water quantity problems include flooding, groundwater depletion, low streamwater, inadequate municipal water systems, and urban growth demands. Eleven water quality problems (such as heavy water chloride content, excessive mineralization in groundwater supplies, low stream flows, industrial waste effluents, acid mine drainage) have also been identified. Eight specific research areas have been determined to address the identified priority Oklahoma water resources problems. (Zielinski-MAXIMA)
W82-05301

WATER QUALITY ASSESSMENT FOR AGANA SPRINGS,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5A.
W82-05304

AN EVALUATION OF TWIN WELLS FOR USE WITH WATER SOURCE HEAT PUMPS,
Louisana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05307

A REPORT ON: RESEARCH NEEDS....WATER CONSERVATION IN AGRICULTURE,
For primary bibliographic entry see Field 3F.
W82-05308

PARAMETRIC ANALYSIS OF DIRECT-CONTACT (PISTONLESS) WORK EXCHANGER FOR REVERSE OSMOSIS APPLICATIONS,
Hittman Associates, Inc., Columbia, MD.
For primary bibliographic entry see Field 3A.
W82-05309

WATER QUALITY PLANNING IN THE NORTHEAST AND MIDWEST: THE SECTION 208 EXPERIENCE,
Atlantic Environmental Associates, Inc., Waltham, MA.
J. J. Goldrosen, and G. C. McMahon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224908, Price codes: A10 in paper copy, A01 in microfiche. Report, September 1981. 219 p, 57 Ref, 2 Append. OWRT C-90244-U(No 0525)(1), 14-34-0001-0525(1).

Descriptors: *Water quality, *Research priorities, *Planning, *Institutional constraints, *Political constraints, *Assessments, Economic aspects, Economic feasibility, Economic impact, Cost allocation, Water law, Legal aspects, State jurisdiction, Political aspects, Federal jurisdiction, Policy making, Administrative decisions.

Examination is made of institutional obstacles to water quality planning for urbanizing areas, based on the experiences of Section 208 planning programs conducted in fifteen States of the Northeast and Midwest U.S. The focus is on the institutional, rather than the technical, obstacles to plan implementation. These obstacles include inadequate recognition of water quality problems, difficulty in financing identified solutions, insufficient legal or regulatory authority, local resistance to water quality planning, lack of cooperation among local political units, and lack of cooperation among different government levels. Most of the information used was obtained through direct contact with individuals involved in preparing the Section 208 plans, with nine of the programs selected for on-site visits. An analysis was made of the factors which affected the ability of various agencies to overcome the identified obstacles and to implement solutions to water quality problems. The fifteen States studied were Connecticut, Delaware, Illinois, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin. The Section 208 agencies have fulfilled, to

some extent, all three of their requisite roles, as catalysts, planning consultants, and providers of technical assistance for areawide water quality management. (Zielinski-MAXIMA)
W82-05315

AN ANALYSIS OF THE APPROPRIATENESS OF WIND AND OTHER ENERGY SYSTEMS FOR IRRIGATION WATER PUMPING IN INDIA,
National Aeronautical Lab., Bangalore (India).
S. K. Tewari.
Agricultural Water Management, Vol 4, No 4, p 445-455, December, 1981. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Wind, *Irrigation, Pumps, Alternative planning, *Energy sources, *India, Water delivery.

Wind energy can be used in a variety of agricultural and industrial applications requiring shaft power, such as water pumping. The appropriateness of wind energy as a source of power for irrigation water pumping was investigated in India in terms of energy availability, cost factors, social priority for the use of particular energy resources for specified applications, organizational and maintenance problems, likelihood of social acceptance, creation of local employment opportunities, and the use of locally available resources. Analysis was carried out on these seven factors in two ways: quantification in respect to possible alternative choices of energy conversion systems, and via the relative importance of these factors, so that a single total value of appropriateness can be computed. Of the options considered, windmills scored the highest appropriateness, with the solar pump being the second best option, followed by photovoltaic conversion. When the qualitative attributes were considered as well, windmills were rated highest, followed by solar pumps, photovoltaic conversion, biogas, solar thermal devices, electrical pumps and diesel pumps. The total appropriateness score including cost factors ranked electrical pumps first, followed by diesel pumps, biogas engines, windmills, solar thermal devices, solar pumps, and photovoltaic devices. (Baker-FRC)
W82-05357

CAN THE GOALS OF THE UN DECADE ON WATER SUPPLY AND SANITATION BE ACHIEVED,
Amsterdam Water Works (Netherlands).
C. van der Veen.
Aqua, No 1, p 18-21, 1982. 1 Tab.

Descriptors: *Developing countries, *Water resources development, *Drinking water, Sanitation, Planning, Water supply, *United Nations, *International Drinking Water Supply and Sanitation Decade, Energy, Rural areas, Population dynamics, Political aspects, Economic aspects, Political constraints, *Evaluation.

It is unlikely that the goals of the United Nations International Drinking Water Supply and Sanitation Decade will be met by 1990. Particular problems are population growth, economic recession, large sums spent for armaments, and the increasing cost of energy. However, it is probable that substantial progress will be evident by the end of the decade and that the water goals can be met within two decades. Necessary conditions are: public awareness of needs, development of political priorities, government organization at all levels, adequate planning, community participation, private enterprise involvement, a high status image of water projects and persons working on the projects, good quality management, sound financial basis, and aid to rural areas. (Cassar-FRC)
W82-05365

THE SHUBENACADIE-STEWIACKE RIVER BASIN STUDY,
Department of the Environment, Halifax (Nova Scotia).
R. H. Bailey.
Canadian Water Resources Journal, Vol 6, No 4, p 187-204, 1981.

Descriptors: *Water management, *River basins, *Water quality management, Bank erosion, Water quality, *Shubenacadie-Stewiacke River, *Nova Scotia, Land use, Economic aspects, Institutional constraints, Regulations, Planning, Water policy, Public participation, Canada.

A study of the 1976-80 Shubenacadie-Stewiacke River Basin, the largest in Nova Scotia, revealed that most of the critical problems in the basin are in an embryonic stage. Water quality problems at present are related to streambank erosion and natural concentrations of undesirable ions in well waters. The major threat to water quality will probably arise from the cumulative effects of small resource use decisions, rather than from the large developments which require intensive environmental scrutiny. The study board concluded that the existing water management framework is not adequate to manage these cumulative developments. Recommendations included: a shift in emphasis from a reactive approach toward a planning approach, an increase in capability to handle long-term cumulative effects of economic activities, coordination among agencies at all levels of government, and an increase in public participation in development and implementation of these objectives. Instituting a Water Resources Management Center at a Nova Scotia university was also suggested. (Cassar-FRC)
W82-05385

DOES CONVENTIONAL SEWAGE TREATMENT MEET THE DEMANDS OF THE 1980'S,
For primary bibliographic entry see Field 5D.
W82-05407

FIVE-YEAR PLAN OF THE WATER RESOURCES RESEARCH CENTER,
College of the Virgin Islands, St. Thomas.
R. U. Champney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231960, Price codes: A02 in paper copy, A01 in microfiche. Report, July, 1981. 8 p, 1 Tab.

Descriptors: *Virgin Islands, *Research priorities, *Planning, *Water management (Applied), *Water resource development, *Water shortage, Water supply, Water demand, Water use, Groundwater potential, Potable water, Desalination, Semiarid lands, Water importing, Brackish water, Wastewater treatment, Water quality.

Water research and development needs for the Virgin Islands for the five years starting with fiscal year 1982 are summarized. Water problems relate to the observation that water supply falls far short of water demand, and that the available water is largely of subpotable quality. This plan focuses on evaluating individual Virgin Island watersheds relative to water storage capacity, recharge rates, on permissable water withdrawal rates on one hand, and on investigating possible methods of achieving and maintaining high quality water in the public water distribution system, on the other. Average annual rainfall varies from 40-45 inches, but demand for rainfall by evapotranspiration exceeds the supply, and the Islands are classified as semi-arid. For all practical purposes, the Islands have no surface water, and groundwater resources are largely unknown and brackish. Water deficits have been addressed by water importation and desalination plant installation; the former is inefficient. Major problems include: inadequate potable water supply and public distribution system; polluted water in the distribution system; and inadequate wastewater treatment facilities. The highest research priority is a needed assessment of groundwater resources. The second highest priority will be studies of pollution in public water related to source identification and remedy. (Zielinski-MAXIMA)
W82-05526

A FIVE-YEAR PLAN OF WATER RESOURCES RESEARCH.
Auburn Univ. AL. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232042, Price codes: A03 in paper copy, A01 in microfiche. Report, 1981. 39 p, 2 Fig, 3 Tab, 33 Ref.

Descriptors: *Alabama, *Research priorities, *Planning, *Water management (Applied), *Water resources development, Water supply, Water resources institutes, Water demand, Groundwater availability, Irrigation water, Aricultural runoff, Groundwater pollution, Coal mining, Strip mine wastes, Surface water availability, Sediment load, Water quality, Water use, Legal aspects, Institutional constraints.

This plan includes a brief description of Alabama's water resources, physical geography, and geology. The use of Alabama's water resources, estimated at 52 billion gallons/day, is described, and water resources problems are identified. Data indicate that there is no general water shortage at the present time and that none is anticipated. Projections of water use are included to the year 2020. Six problem areas to be addressed were identified from a listing of 27 major water and related land resources problems facing Alabama. The six problems for research plan focus are: inadequate data and methods concerning water supply as related to groundwater quantity and quality; a projected competing increased demand on groundwater resources in southern Alabama for irrigation; groundwater contamination from agricultural and other practices/sources, including the need for improved monitoring; adverse effects of strip and subsurface mining on water supplies; and heavy sediment loads degrading water quality. The six problem areas fall under one or more of five generic research categories (e.g., atmospheric/hydrologic/hydraulic processes; water quality processes; water resources management; ecologic-environmental relationships; institutional, legal, and other constraints. (Zielinski-MAXIMA)
W82-05527

FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT GOALS AND OBJECTIVES FOR WYOMING.
Wyoming Univ., Laramie. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231978, Price codes: A06 in paper copy, A01 in microfiche. Report, July, 1981. 96 p, 2 Fig, 12 Tab, 7 Ref, 1 Append.

Descriptors: *Wyoming, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Water supply, Water quality, Water use, Water conservation, Flurial sediments, Flooding, Water harvesting, Weather modification, Groundwater recharge, Water rights, Legal aspects, Institutional constraints, Economic aspects.

This report dicusses Wyoming's land/and water resources, water uses and problems, water and related land planning and development activities, and priority water issues that need attention. Wyoming contains seven river basins and the headwaters of four major river basins, with over 90% of the water flowing through Wyoming originating within its boundaries. Large groundwater stores are also present. Wyoming water use is constrained, however, by the appreciation system of water laws and by compacts with neighboring states. Further, water competition among Wyoming's three most prosperous economic sectors (minerals, recreation/tourism, and agriculture) will become increasingly serious as natural resources development continues. Issues needing attention in the water quantity area are: water availability, flurial morphology, flooding, water harvesting, weather modification, and groundwater recharge. Water quality issues are related to municipal, agricultural, and industrial concerns. Water use and conservation topics include: water use efficiency in food/fiber production and for municipal/industrial use, institutional incentives for conservation, coservation practice impacts on hydrologic systems, water reuse, and instream flow needs. Economic/institutional water concerns are also discussed. (Zielinski-MAXIMA)
W82-05528

VIRGINIA WATER RESOURCES RESEARCH CENTER FIVE-YEAR PLAN.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231986, Price codes: A08 in paper copy, A01 in microfiche. Report, June, 1981. 143 p, 3 Fig, 7 Tab, 1 Append.

Descriptors: *Virginia, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Management planning, Information systems, Land management, Surface water availability, Groundwater pollution, Environmental protection, Water quality, Monitoring, Sludge disposal, Groundwater management, Water supply, Water use.

This report describes Virginia's water resources, the significant problems affecting them, and a five-year plan for dealing with these problems from fiscal year 1983-87. Priority problems were identified in each of eight areas: water supply, inventory and monitoring, resource management, nonpoint source pollution, flood damage abatement, outdoor recreation, waste treatment, and marine environment, with the first four identified as the highest priority problem areas. The most significant water resources problem can generally be characterized as problems of management, with the most pressing being the lack of a comprehensive water resources management plan. The five-year activity plan is based on attainment of eight specified goals, each having specific objectives. Two goals concern public education and information dissemination activities to increase public awareness of water resources. A third goal involves continued identification of current priority water problems and current information on critical problems. The remaining five goals address the solution of specific priority problems: developing a comprehensive resources management plan; land management plans for surface and groundwater protection; a sludge-disposal polity; improved routine water quality monitoring; and methods to promote an outdoor ethic. Delineation of 60 important water problems facing Virginia is included. (Zielinski-MAXIMA)
W82-05529

MICHIGAN FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT PLAN: FISCAL YEARS 1982-1986.
Michigan State Univ., East Lansing. Inst. of Water Research.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231994, Price codes: A04 in paper copy, A01 in microfiche. Report, 1980. 47 p, 5 Tab, 15 Ref.

Descriptors: *Michigan, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Hazardous materials, Toxins, Water pollution, Nonpoint pollution sources, Pollution load, Eutrophic lakes, Wetlands, Groundwater pollution, Economic aspects, Water quality, Water use, Water supply.

As a background and basis for Michigan's five-year water resources research plan, this report provides a general overview of the status and problems of Michigan's water resources. While Michigan has an abundant and diverse source of freshwater due to its geographical location within the upper Great Lakes region, nearly all of its urban/industrial/agricultural wastes drain to the Great Lakes where their impact is accentuated due to the slow flushing rate of the Great Lakes system. Michigan's most critical water resource problem is, hence, water quality management. The continued availability of suitable water to meet diverse State and regional needs is dependent on actions to prevent water quality degradation. To assist the resolution of Michigan's water resources problems, this research plan is focused on three major areas: development of a comprehensive State water resources atlas; continuing and expanding technology transfer and information dissemination; and conducting a research program under six priority categories. These categories concern; fate/transport/effects of toxic/hazardous water pollutants; mechanisms influencing nonpoint source pollution; control and management strategies to minimize entrophication impacts on lakes; defining functinal and economic value of wetlands and effects of physical/chemical/biological variables on groundwater quality and quantity. (Zielinski-MAXIMA)
W82-05530

A FIVE-YEAR PLAN FOR WATER RESEARCH IN COLORADO,
Colorado Water Resources Research Inst., Fort Collins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232059, Price codes: A07 in paper copy, A01 in microfiche. Report, January, 1981. 127 p, 20 Fig, 8 Tab, 15 Ref, 3 Append.

Descriptors: *Colorado, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Water quality control, Water supply, Water use, Water demand, Competing use, Runoff forecasting, Groundwater recharge, Heavy metals, Water pollution, Groundwater pollution, Saline water, Mineral industry.

This report covers a detailed description of Colorado water resources, the institutional interrelationships of Colorado water organizations, and the projected five-year water resources research plan. A listing of 22, 14, 21, 36 and 31 researchable water problems of high water priority for Colorado is given for the five generic research categories: atmospheric/hydrologic/hydraulic processes; ecological-environmental relationships; water quality processes/prediction/protection; water resources management; and institutional/political/legal/behavioral/economic analysis, respectively. These priority water problems reflect four primary objectives: maximize the beneficial use of the annual water supply; augment the annual supply; minimize water quality degradation; and resolve competitive demands for water. The five-year research program will be drawn from 49 research problem areas under these four primary objectives. The research needed for each of this area is tabulated. A programming guideline protocol for problem-solving water research using a programming and execution process which includes program evaluation is provided. An inventory of current water resources studies in Colorado is also included. (Zielinski-MAXIMA)
W82-05531

FIVE YEAR WATER RESOURCES RESEARCH PLAN FOR THE STATE OF CALIFORNIA,
California Univ., Davis. Water Resources Center.
R. W. Hinks, and J. H. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232034, Price codes: A05 in paper copy, A01 in microfiche. Report No 49, October, 1980. 73 p, 7 Fig, 9 Tab, 34 Ref. 14-34-0001-0480, UCLA-WRC-W-100.

Descriptors: *California, *Research priorities, *Planning, *Water management(Applied), *Water resources development, *Groundwater management, Competing use, Water use, Water demand, Water supply, Available water, Groundwater reservoirs, Wastewater renovation, Water conservation, Water quality, Environmental production, Institutional constraints.

This report presents an analysis of the current status of California's water resources problems and identifies areas of recorded research for a five-year planning period of fiscal year 1983-87. Priority classification tables are presented which indicate the relative importance of specific areas of research activity. A major characteristic issue of California water resources between now and the year 2000 is the inevitable competition between agricultural and nonagricultural uses for a strictly limited and fixed water supply. Background information is given on physical factors that influence California water resources, and the use of these resources is delineated with respect to water demand, development, management alternatives, and identified problem areas to meet the expected future demand. Problems included additional construction needs, and current management policy regarding groundwater, wastewater reclamation/conservation, environmental protection, and water quality. Research needs are proposed under six areas. Thirty-two research needs are prioritized under categories of very high, high, and medium priority. Very high priority research needs (of 9 identified), include: water quality related to health and salinity; water development and management alternatives; and improved information dissemination for all aspects of water research activities. (Zielinski-MAXIMA)
W82-05532

NEVADA WATER RESOURCES RESEARCH 1982-1987,
Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236928, Price codes: A09 in paper copy, A01 in microfiche. Report, October, 1980. 80 p, 6 Fig, 20 Tab, 3 Append.

Descriptors: *Nevada, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Groundwater recharge, Aeration zone, Flow characteristics, Groundwater availability, Water supply, Water use, Deep wells, Conjunctive use, Coal mining, Water quality, Water conservation, Water reuse, Institutional constraints, Legal aspects.

Water resources problems and research needs for Nevada are described. Water resources are detailed under categories of surface water, groundwater, and the available water supply. Uses of water resources (e.g., irrigation, livestock, mineral industry, electric power, municipal and industrial) and conflicts in water uses are discussed. The most urgent problem areas needing attention are: groundwater recharge, unsaturated zone flow mechanics, groundwater availability, deep aquifer studies, conjunctive use, water reuse, water conservation, legal/institutional issues, and effects of mining on water quality. These problem areas are described in matrix form relative to specific hydrographic regions. Identified research priorities are arranged under five broad categories: atmospheric/hydrologic/hydraylic processes (e.g., flow mechanics in the unsaturated zone, groundwater and aquifer recharging, modeling rainfall-runoff-recharge in arid regions); ecologic-environmental relationships (methodology to slow/reverse nutrient overloading, quantitative evaluation of algal growth processes); water quality (soil-water interactions regarding contaminants, groundwater contamination, pollutant transport); resources management (long-term effects of energy/mineral development, agricultural water conservation, water resources planning, water reuse innovations); and institutional/political/legal/behavioral/economic analysis. (Zielinski-MAXIMA)
W82-05533

INTERNAL RATES OF RETURN DERIVED FROM THE PAY-BACK PERIOD,
Hershev - The Inter-Kibbutz Economic Unit, Tel Aviv (Israel).
Y. Goldschmidt, and L. Shashua.
Omega - The International Journal of Management Science, Vol 8, No 6, 1980. p 695-696. 2 Tab. OWRT B-080-ARIZ(6).

Descriptors: *Rate of return, *Financial feasibility, *Economic yield, *Cost analysis, *Algorithms, Mathematical studies, Economic aspects, Economics of scale, Economic efficiency, Economic evaluation, Economic justification, Cost allocation, Econometrics, Financing, Input-output analysis, Investment, Payment, Management planning.

Simple tools (tables and rules of thumb) are developed for deriving the internal rate of return (IRR) from the pay-back perion (PBP), to bridge the gap over the disparity between theory and business practice regarding capital budgeting. The PBP of a proposal for an investment project is the time needed for accumulated expected cash flow (net returns) to reach the initial cost of the investment; the IRR of the project is the rate of discount which equates the present value of the expected cash flow to the initial cost of the investment.

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Given the PBP and the expected service life, the IRR is derived directly from tables, or roughly approximated by simple rules of thumb. Initially, the PBP can be used to provide a rough screen of proposed investment projects; final screening is carried out by checking the IRR, using the tables. The table provide percentage values of service life (from 5-14 years) of the IRR and of the certainty equivalent rate of return, as a function of the number of years (2.0-7.0) of pay-back. If a proposed investment project is expected to yield a constant cash flow, uncertainty can be assumed by approaching the cash flow as if it would decline with time. Hence, using the appropriate table (or rule) provides both the expected and the certainty equivalent IRR of the investment. These tools enable decision-makers to introduce an uncertainty effect into the straight-forward PBP computation, which permits a check of the sensitivity of a proposed investment. (Zielinski-MAXIMA)
W82-05542

DOMESTIC WATER CONSERVATION RESEARCH PLAN,
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236613, Price codes: A02 in paper copy, A01 in microfiche. Report, July 7, 1978. 17 p, 5 Tab. (No 8544)(1).

Descriptors: *Water conservation, *Research priorities, *Metropolitan water management, *Domestic water, *Water costs, Water use, Planning, Policy making, Public policy, Economic evaluation, Management planning, Available water, Water supply, Heated water, Water management, Reclaimed water, Water reuse.

A four-year plan (1978-1982) is described which identifies research needs to improve domestic water conservation. The plan addresses various needed assessments concerning hardware and water management practices for both indoor (e.g., toilet water, bath and shower water, laundry water) and outdoor (landscape maintenance) domestic uses of water. Research needs concerning ten indoor water themes (e.g., water use and energy impacts, economic analysis, institutional incentives, user acceptance) and five outdoor water themes (e.g., baseline data, new device technology, use of reclaimed water) are delineated. Seventeen water resource issues that directly or indirectly relate to residential water conservation are brefly reviewed, with the fastest growing cost issue being energy needed for pumping and heating water. The objectives of this research program are targeted providing basic data needed by policy makers and water managers for implementing water conservation policy; and reducing current residential water usage by 50% by increasing water use efficiency. Assuming an annual domestic water use of 100,000 gallons at a cost of $0.55/1000 gallons, a savings of $2.2 billion dollars is possible in water costs alone; if energy is included, the savings could potentially exceed $8 billion dollars/year. (Zielinski-MAXIMA)
W82-05547

INSTITUTIONAL PROBLEMS OF WATER QUALITY PLANNING IN URBANIZING AREAS IN THE PACIFIC NORTHWEST,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
K. Wehbring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236688, Price codes: A05 in paper copy, A01 in microfiche. Report, September, 1980. 75 p, 1 Tab, 29 Ref, 1 append. OWRT C-90094-U(No 9433)(1), 14-34-0001-9433.

Descriptors: *Water quality management, *Planning, *Urbanization, *Institutional constraints, *Regional development, Urban watersheds, Water quality, Water quality control, Urban drainage, Urban areas, Urban hydrology, Urban planning, Legal aspects, Economic aspects, Government finance, Political aspects, Community development, Social aspects, Social needs.

Institutional obstacles (including legal, financial, organizational, inter-governmental, political, and social aspects) revealed in the 208 program water quality planning process of 12 Pacific Northwest urbanizing areas are analyzed to assess their impact on planning. Attention is focused on the identification and analysis of institutional obstacles related to wastewater management, urban stormwater runoff, and agricultural runoff. The 208 plans for the 12 areas studied are identified by the major regional city in the planning area; these cover three cities in Washington (Seattle, Everett, and Vancouver), five in Oregon (Portland, Salem, Eugene, and Medford/Ashland), three in Idaho (Boise, coeur d'Alene, and Pocatello), and one in Alaska (Anchorage). Wastewater management obstacles identified are: public opposition to increased water quality costs; land use and urban growth controversies; political aspects of annexation and incorporation; and the existing multilicity of sewerage agencies. Identified obstacles related to urban stromwater and agricultural runoffs are: lack of understanding of water quality problems and lack of will to undertake water quality improvement programs; lack of federal assistance for urban stormwater runoff control; fragmentation of authorities, both jurisdictional and inter-governmental, affecting water quality planning for agricultural and urban runoff; the absence of adequate codes and ordinances for enforcing water quality needs; and the lack of implementing authority by the councils of government which developed the areawide 208 plans. (Zielinski-MAXIMA)
W82-05554

EFFICIENT WATER USE IN CALIFORNIA: CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE RESERVOIRS,
Rand Corp., Santa Monica, CA.
For primary bibliographic entry see Field 4B.
W82-05628

DROUGHT MANAGEMENT: EXPECTING THE UNEXPECTED,
Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.
For primary bibliographic entry see Field 3D.
W82-05649

THE COST AND EFFECTIVENESS OF PUBLIC NOTIFICATION OF MCL VIOLATIONS,
Pittsburgh Univ., PA. School of Education.
For primary bibliographic entry see Field 5G.
W82-05669

DROUGHT-RELATED WATER CONSERVATION EFFORTS IN MISSOURI,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W82-05672

COMPARING TWO MEASURES OF WATER BASED RECREATION PARTICIPATION,
Wisconsin Univ.-Madison. Dept. of Forestry.
For primary bibliographic entry see Field 6D.
W82-05733

ECONOMIC EVALUATION OF WATERSHED PROJECTS--AN OVERVIEW METHODOLOGY AND APPLICATION,
Minnesota Univ., St. Paul. Coll. of Forestry.
K. N. Brooks, H. M. Gregersen, E. R. Berglund, and M. Tayaa.
Water Resources Bulletin, Vol 18, No 2, p 245-250, April, 1982. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Cost-benefit analysis, *Economic analysis, *Watershed management, Benefits, Rehabilitation, Project planning, Erosion, Sedimentation, Loukkos River, Morocco, Soil management, Land use, Channel improvement, Reforestation, Reservoirs, Irrigation.

A practical, low cost approach for integrating physical and biological considerations for economic analysis of proposed watershed rehabilitation projects is illustrated via a project for the Loukkos Basin in northern Morocco. The economic analysis is conducted in four steps: (1) defining present and proposed physical conditions of erosion, sedimentation, etc., (2) developing value estimates and value flow tables in terms of monetary values, (3) calculating project worth by such measures as net present worth or economic rate of return, and (4) testing the sensitivity of the measures of project worth to change in assumptions. The four steps are applied to an analysis of the 182,000 ha Loukkos watershed, which is physically degraded, with compacted soil surface, nutrient depletion, soil salinizatin, and mass movement problems. Proposed corrective measures include road construction, channel stabilization, reforestation, pasture management, and planting olive trees, at a total cost of $26.1 million. Analysis indicated that the net benefits would be negative for the first 7 years of the project and rise to $21.71 million per year by the fiftieth year. (Cassar-FRC)
W82-05735

LOCAL ATTITUDES TOWARD ALTERNATIVE USES OF A RESERVOIR PROJECT,
Ohio State Univ., Columbus. Dept. of Development Sociology.
T. L. Napier, M. V. Carter, and E. G. Bryant.
Water Resources Bulletin, Vol 18, No 2, p 211-219, April, 1982. 5 Tab, 27 Ref.

Descriptors: *Attitudes, *Reservoirs, *Water resources development, Public opinion, Social impact, Economic impact, Ohio, Alternative planning, Multipurpose reservoirs, Surveys, Benefits, Cost-benefit analysis, Recreation.

Residents of a dispersed rural central Ohio community were asked about their attitudes concerning the funds allotted for a multi-purpose reservoir built in that area about 10 years previously. As a group, the local people were satisfied that the lake project had been built with the available resources in preference to several other development options (industrial parks, better public services, state or national park, public water supply wells, aid to small business, help for the poor, construction of several smaller impoundments, and allocations for private recreational development). Only one option, keeping the land in its original state of forests and agriculture, was slightly favored over the lake project. A vested interest perspective was used to investigate socio-demographic, attitude, and cost assessment factors. The findings showed that costs and benefits were good predictors of attitudes toward the project. That is, persons who benefited from the lake project had favorable attitudes toward the lake, while those who experienced costs as a result of the project favored alternate options. Long-term residents tended to favor the alternative development options, whereas nonfarmers, persons with higher educational achievement and those with negative perceptions of recreationists tended to favor the lake project. (Cassar-FRC)
W82-05743

EFFECTS OF POTENTIAL WATER CONSERVATION EFFORTS IN EAST TENNESSEE,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
For primary bibliographic entry see Field 3D.
W82-05745

WATER RESOURCES RESEARCH PRIORITIZATION AND MANAGEMENT--PROBLEMS AND PERSPECTIVES,
Utah Water Research Lab., Logan.
L. D. James, and J. Messer.
Water Resources Bulletin, Vol 18, No 1, p 1-7, February, 1982. 7 Tab, 4 Ref.

Descriptors: *Water resources development, *Research priorities, Water quality, Resources management, Planning.

Water resources research is essential to the protection of water quality and to the wise use of limited water resources. Research management must prioritize study topics and foster their productive completion in order to maximize research productivity. However, the water research management struc-

ture found in the Federal government and in the States is strongly influenced by pervasive trends toward consumerism, which identifies current users and makes them the judges of worth; fiscal constraint, which tends to focus research on user-recognized early payoffs; centralized management; and the use of research for other social objectives. The research prioritization and management structure which these trends have created was examined in the microcosm of its application at the Utah Water Research Laboratory. This review indicated that research productivity is seriously diluted by the failure of research users to communicate their particular needs to researchers and by the effects of consumerism in terms of ephemeral and volatile priorities which work against sustained research thrusts over the durations required to deliver research results to users who recognize their needs. Corrective approaches to research management might include incremental research prioritization and greater use of advisory councils to facilitate user-research interaction. The only firm conclusion drawn is that empirical studies of the performance of alternatives in research management structure are needed. (Carroll-FRC)
W82-05753

TURKS PRESS FORWARD WITH AMBITIOUS DAM PROGRAMME,
G. Tansey.
World Water, Vol 5, No 3, p 22-25, March, 1982. 1 Fig.

Descriptors: *Water resources development, *Financing, *Developing countries, *Turkey, Dam construction, Hydroelectric power, Irrigation, Reservoirs.

Rising oil costs have encouraged water resources development in Turkey, which currently uses only 10% of its 100 TWh potential hydropower. Installed capacity is 1171 MW. Thirteen projects (7219 MW capacity) are underway, and 34 projects (6529 MW) are in the planning stage. The Hasan Ugurlu, a 179 m high earthcore rockfill dam completed in 1979, was the first major dam built by a Turkish company with a Turkish workforce. Only 6 minihydro plants have been built, all in remote areas. No studies have been done on the minihydro potential. The goal for increasing the present 40,000 sq km of irrigated land is 100,000 ha per year. Irrigation projects have been moving rapidly near the Mediterranean and Aegean coasts, but more slowly in the central and east. Financing water projects has been a major deterrent to development. Water prices have been unrealistically low, and foreign money is hard to obtain. This lack of funds has slowed several major dam construction projects. Other difficulties are water rights conflicts with Syria and Iraq and a shortage of skilled workers. (Cassar-FRC)
W82-05758

A REVIEW OF THE BENEFIT-COST ANALYSES OF TWO SOUTHERN ALBERTA DAMS,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
M. Gysi.
Canadian Water Resources Journal, Vol 5, No 1, p 76-86, 1980. 8 Ref.

Descriptors: *Cost-benefit analysis, *Benefits, Water management, *Canada, Dams, Oldman River Dam, Red Deer River Dam, *Alberta, Irrigation, Industrial development, Employment, Economic justification.

Benefit-cost ratios for the Red Deer River and Oldman River dams in southern Alberta were based on grossly inflated benefits. The Phase I Study for Oldman River Dam used a multiplier of 1.5 to compute the secondary benefits from the primary (irrigation) benefits. Using a more acceptable multiplier of 0.1 reduces benefits by $66 million. In addition, the primary and secondary employment wages benefits ($16.5 million) should not have been included, considering Alberta's fully employed economy. These deductions change the original benefit/cost ratio of 1.59 to 0.65. Phase II of the Oldman River Study removed huge farmers' costs of irrigation and added an unwarranted 45% regional secondary benefits. Benefit/cost ratios were subjected to sensitivity analysis fby four methods and the most favorable reported, rather than the more realistic 1.1-1.3. The Red Deer River Dam, a flow regulation dam already approved, listed employment benefits (dam and resulting industrial development) as the only benefits. The major error was the assumption that all industrial development was attributed to the dam. In fact, employment benefits from a petrochemical plant, approved for construction before any commitment to build the dam, were also attributed to the dam. The decision to build Red Deer Dam was political and not based on economic reasons. Alberta Environment has made efforts to improve and standardize benefit/cost methods. (Cassar-FRC)
W82-05766

UNIFIED RIVER BASIN MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Geography.
B. Mitchell.
Canadian Water Resources Journal, Vol 5, No 2, p 87-95, 1980.

Descriptors: *Water basin development, Water management, *Water policy, Planning, Management planning, Institutional constraints, Symposium.

A symposium on unified river basin management was presented May 4-7, 1980, at Gatlinburg, Tennessee, by the American Water Resources Association and Tennessee Valley Authority with assistance from other organizations. Three keynote addresses concerned the following subjects: the accomplishments and challenges of the TVA, the history and difficulties faced by integrated river basin development, and evolution of organizational arrangements for river basin management. Authors of the 61 papers did not agree on a definition or the universal need for unified river basin management. A variety of approaches have been successful in the past, depending on local physical characteristics, public attitudes, etc., and may not be suitable for the future. Success of a management program depends on whether the managers or the public are evaluating the program. Planners should be in closer contact with the realities of implementation. Trade-offs and compromises are necessary in river basin planning. Constraints should be recognized and incorporated into solutions rather than reaching for a theoretically optimum solution. (Cassar-FRC)
W82-05769

ROLE OF THE MICROCOMPUTER IN WATER MANAGEMENT,
Canadian Applied Technology, Buttonville, Ontario.
For primary bibliographic entry see Field 7B.
W82-05771

THE EIGHTIES--IMPLICATIONS FOR WATER MANAGEMENT,
Ministry of State for Economic Development, Ottawa (Ontario).
C. D. Burke.
Canadian Water Resources Journal, Vol 5, No 2, p 1-12, 1980. 46 Ref.

Descriptors: *Planning, *Water management, *Water demand, Canada, Long-term planning, Population dynamics, Employment, Energy, Biological treatment, Water pollution, Water quality, Climatology, River basins, Forecasting, Water conservation, Research priorities.

An address presented at the Keynote Session of the CWRAS National Conference in 1980 looks 10-20 years into the future for three reasons: to eliminate self-solving problems, to pick up growth-related problems, and to stay ahead of needs. Trends in population numbers and distribution, employment, fuels, and energy in Canada are predicted. In environmental issues there will be a shift in emphasis from the visible pollutants to the insidious pollutants (polychlorinated biphenyls, acid rain, etc.) and an emphasis of on global environmental problems such as climate change. Water management issues vital during the next 10 years are described. The river basins subject to most pressure in the next decade are those located in Southern Alberta, the Saskatchewan, the Fraser Estuary, the Mackenzie, and the Great Lakes. Municipal water demands will show less growth except in Calgary and Edmonton. Hydropower will concentrate on low-head dams, in-stream sites, and tidal power. Heavy water demands for energy development can be expected in Alberta. More attention will be given to water use efficiency, climate variability, biological sewage and water treatment, trace levels of pollutants in water, and the danger of a burgeoning government water management bureaucracy. (Cassar-FRC)
W82-05772

WATER MANAGEMENT IN THE METROPOLITAN TORONTO REGION,
Metropolitan Toronto and Region Conservation Authority, Downsview (Ontario). Water Resource Division.
M. R. Garrett.
Canadian Water Resources Journal, Vol 5, No 1, p 78-86, 1980. 2 Fig.

Descriptors: *Storm water, *Urban runoff, *Water management, *Metropolitan water management, Runoff, Land development, Land use, Land acquisition, Flood plains, Risks, *Toronto, Ontario, Planning, Watershed management, Urban hydrology, Urban drainage, Storm runoff, Flood control, Flood plain management, Flood protection, Urban planning, Urban watersheds.

The Metropolitan Toronto and Region Conservation Authority began its comprehensive watershed plan with a 3 year data gathering process. Some preliminary conclusions were developed. The hazard land acquisition program should be continued and vulnerable structures removed. An erosion control works program should be continued. Remedial works should be continued. Remedial works should be continued so that no development is exposed to the risk of a 100-year flood, or greater in some cases. Major flood damage areas can be redeveloped if the risk level has been reduced to a satisfactory level. Risk must be defined as risk to life and property, not minor inconvenience. The flood control program must recognize the varying valley characteristics. Objectives have been established for storm water management in the areas of provision of servicing, reduction of hazard, conservation, planning, and economics. (Cassar-FRC)
W82-05775

WATER MANAGEMENT IN THE MARITIMES,
New Brunswick Dept. of Fisheries and Environment, Fredericton.
W. F. G. Cardy.
Canadian Water Resources Journal, Vol 5, No 3, p 26-33, 1980.

Descriptors: *Water management, *Attitudes, *Water policy, Canada, Nova Scotia, New Brunswick, Prince Edward Island, Water supply, Water use, Public opinion, Water resources development, Planning, Hydroelectric plants, Multipurpose projects.

The abundant water resources of Canada's Maritime provinces, New Brunswick, Nova Scotia, and Prince Edward Island, have been more than sufficient to satisfy the demands of the 1.65 million population. Until recently, water problems such as pollution control, control of water course alterations, and water rights establishment have been handled on an individual basis. The present job of water managers is to shape public attitudes toward water resources. The concepts that must be communicated are that minor crises are usually part of a larger, developing problem and that water is a valuable resource. With a reshaping of attitudes toward water, management policies can be implemented with respect to multiple use of hydrostation reservoirs, protection of drinking water sources, and improved reservoir operation. (Cassar-FRC)
W82-05776

USDA-NAL, Beltsville Branch

STORMWATER MANAGEMENT - ONE DEVELOPER'S EXPERIENCE,
Major Holdings Ltd., Kitchener (Ontario).
G. W. Wright.
Canadian Water Resources Journal, Vol 5, No 2, p 68-77, 1980. 3 Fig.

Descriptors: *Political constraints, *Storm water, *Urban drainage, Planning, Drainage engineering, Ontario, Urban development, Water policy, Water management.

Major Holdings Limited, and Ontario developer, planned advanced stormwater management for some large resiintial developments but experienced political problems and resistance to innovative methods. Much enthusiasm for the plans was evident among designers and consultants. However, when the bureaucracy realized that policy changes were necessary, resistance developed. Responsibility for decisions on storm water management was passed from agency to agency. As a result, management designs have been abandoned for current practices, which are more expensive and produce less environmental benefits. (Cassar-FRC)
W82-05777

1980 NEEDS SURVEY: COMBINED SEWER SSITE STUDIES,
Water Resource Engineers, Gainesville, FL.
For primary bibliographic entry see Field 5D.
W82-05862

CONFLICT OVER WATER SOURCES PREDICTED BY GLOBAL STUDY.
World Water, Vol 5, No 4, p 49, 51, April, 1982. 3 Tab.

Descriptors: *Water supply, *Population dynamics, *Irrigation, Prediction, Water resources development, Environmental effects, Forests, Agriculture, Water pollution, Energy, River basins, Developing countries, Wastewater treatment.

The 766-page book, 'The Global 2000 Report to the President', commissioned in 1977 by former President Carter, predicts the status of world population, environmental conditions, and natural resources for the year 2000. The predictions have serious implications for water resource planners. The population increase to 5900-6800 million will be concentrated in already overpopulated and underdeveloped nations and in urban areas. Conflicts over water resources will intensify, especially in multinational basins. Disparities between rich and poor nations will increase. total irrigated land may rise from 223 million ha in 1975 to 273 million ha by 1990. Costs of improving ineffective irrigation and drainage systems are $36,000 million (1975 prices). Increasing irrigation will add to salinity problems downstream from projects. Deforestation, which profoundly affects water resources, will continue until about 2020, when the total forest area will stabilize at 18 million sq km. The environmental will suffer loss and deterioration of agricultural soil caused by soil erosion, stabilization, pollution, and water shortages. Burning of farm wastes for fuel reduce the nutrients and reduce the soil's ability to retain nutrients and water. Water withdrawals in 2000 will be 1800-2300 million cu m, 5 times the present level. The huge sums of money required for treatment of water pollution and wastewater may not be available in developing countries. (Cassar-FRC)
W82-05879

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A SPATIAL COSTING SYSTEM FOR DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, V. F. Fender, and J. I. Gillean.
Journal of the American Water Works Association, Vol 74, No 1, p 18-26, January, 1982. 11 Fig, 2 Tab, 7 Ref.

Descriptors: *Cost allocation, *Water treatment, *Water distribution, Metropolitan water management, Accounting, Costs, Data processing, *Kenton County, *Kentucky, Depreciation, Management planning.

A survey of the data collection and analysis procedures in large water utilities conducted throughout the United States beginning in 1974 revealed that the procedres varied widely and were generally inadequate for cost assessments. A technique has been developed for data collection and analysis to fulfill both managerial and accounting needs. This technique, based on a matrix, spatial assignment concept, was tested with a water supply simulation model and then implemented in Kenton County, Kentucky. The calculation of unit costs is based on revenue-producing water (RPW) rather than total water treated. Each month, the RPW by cost zone is entered onto a worksheet. costs are first charged to cost centers within the physical system and then transferred in increments from the cost centers to the appropriate cost zone, based on the flow of RPW within the zone. The system is designed to produce supplemental management reports and a cost analysis report. Examination of the report unit costs by zone will show trends or deviations from normal costs within a distribution area. A depreciation base was established for water district assets so that depreciation could be properly treated as an operating cost. The system supplied useful management reports and provided the basis for a proposed rate increase. (Carroll-FRC)
W82-04796

THE REAL PRICE OF URBAN WATER,
West Virginia Univ., Morgantown. Regional Research Inst.
P. C. Mann, and P. R. LeFrancois.
Journal of the American Water Works Association, Vol 74, No 1, p 22, January, 1982.

Descriptors: *Pricing, *Municipal Water, *Economic aspects, Water shortage, Water conservation, Public opinion, Industrial water, Maintenance, Water distribution, Inflation, History, *Water supply.

Public perception of the relative importance of water pricing appears to moving away from the neglect which it previously suffered. Recent water shortages have produced much activity among states and user groups to assure future supplies. Inflation and increased quality demands have resulted in more frequent rate increases in the recent past. Growing consumer militancy has generated sentiment to sheild low-income consumers of water service from higher rates, particularly in rural areas. Urban water underpricing has induced water utilities to defer both system maintenance and capital replacement. although the nominal price of water has been increased in most areas, the real price has, on the average declined in the past decade because of inflation. Only the real price of industrial water, not residential or commerical water, increased during 1970-81. If this underpricing is continued, urban water consumers may be confronted at some point with the prospect of either massive increases in rates to cover the renovation of the entire system, or substandard and unreliable water service. (Carroll-FRC)
W82-04797

ESTIMATION OF SUBSTITUTION POSSIBILITIES BETWEEN WATER AND OTHER PRODUCTION INPUTS,
EG and G Environmental Consultants, Waltham, MA.
F. G. Babin, C. E. Willis, and P. G. Allen.
American Journal of Agricultural Economics, Vol 64, No 1, p 148-151, February, 1982, 2 Tab, 16 Ref.

Descriptors: *Water demand, *Pricing, Water use, Industrial water, Economic aspects, *Water rates.

This study examines water use at the standard industrial classification two-digit industry level and employs improved water price information. The translog form used offers advantages in that the ability to model production relationships with several inputs exists without imposing stringent conditions on the elasticity of substitution. From data for the individual sector estimates, it was concluded that changes in the price of water will have little effect on water usage. However, a 1% rise in the price of water would result in a 0.16% drop in the use of capital for the paper and pulp industry. Such a small response makes sense due to the relatively small cost share of the water input. On the other hand, a 1% rise in the cost of capital services for the same industry would lead to a 0.71% reduction in water use. It cannot be assumed that the industries studied in this paper can be pooled on the basis of identical parameters. Estimates found capital and production labor to be substitutes in all industry groups analyzed. However, all other pairs of inputs ere found to be substitutes for some industries and complements for others. Water planners are thus likely to find that elasticities based on pooled data are unreliable indicators of price responsiveness for their specific industrial customers. (Baker-FRC)
W82-04889

RESTRUCTURATION OF THE WATER TARIFF SYSTEM FOR IRRIGATION DISTRICTS IN MEXICO.
Secretaria de Agricultura y Recurosos Hidraulicos, Mexico City.
A. Olaiz.
Journal of Hydrology, Vol 51, No 1-4, p 29-40, May, 1981. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Irrigation programs, *Design criteria, Planning, Model studies, Water use, *Mexico, Tariff, *Economic aspects, Cost sharing.

In the Federal Water Law of 1972, the Mexican government declared irrigation districts to be for the public benefit and established the obligation of all users to contribute to their self-sufficiently by covering the cost of the services they receive on an equitable basis as set by the law. In order to meet expected growth in population and water demand between the years 1975 and 2000, the total irrigated area must be doubled; the efficiency of water use in irrigated plots must be increased by 15% and efficiency increased 8% in total distribution systems. Three major goals were set for 1982: to reach financial self-sufficiency in operation, maintenance and repair annual costs; to deliver water by volume in irrigation plots and establish a water quota per hectare in accordance with resource availability and crop patterns; and to promote higher recovery of the public investment in infrastructure systems. If the method that has been devised is put into practice, the price of water for irrigation will be a powerful tool for improving the undesirable conditions which presently exist. It will also help in intermediate and long-term planning, and in deciding on the best allocation of regional water resources among alternative uses and crops. This would lead to better productive patterns in agricultural development. (Baker-FRC)
W82-04962

OPTIMAL WATER PRICING AND STORAGE: THE EFFECT OF DISCOUNTING,
Canterburg Univ., Christchurch (New Zealand). Dept. of Economics.
R. Manning, and D. Gallagher.
Water Resources Research, Vol 18, No 1, p 65-70, February, 1982. 2 Fig, 13 Ref.

Descriptors: *Pricing, *Water storage, *Discount rates, Economic aspects, Elasticity of demand, Optimization, Storage, Water demand, Interest rates.

Work by Riley and Scherer (1979) concerning the relationship of water pricing and storage policies is extended by considering the role of discounting (or time preference) in pricing policy. Optimal storage policies are described by an extension of Hotelling's rule. (1) The price of water in storage must rise with the rate of interest. The rate of water loss from leakage and evaporation may be included. (2) The initial price for stored water is such that the price of water rises enough to equate demand with natural inflow at the moment when contents are exhausted. (3) The price of storage contents must rise at no less than the rate of interest. When storage contents are exhausted the price must not

rise faster than the rate of interest and must eventually fall to a level that makes the next cycle of storage profitable. (4) The smaller the elasticity of demand, the rate of interest, or the longer the planning horizon, the larger the optimal storage capacity. (5) The price of water must increase over the cycle, but the discounted prices must be the same, and the initial price must be set so that the total demand equals total inflow over the cycle. (6) The price of water must increase over the cycle, but the discounted higher price will exceed the discounted lower price. These prices must be set so that at the end of the applicable intervals the storage contents can meet demand in the next period. (Cassar-FRC)
W82-05049

WATER AND WASTEWATER MANAGERS FACE THE FINANCIALLY TROUBLED 1980S,
Graham Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 6B.
W82-05166

CRISIS-RIDDEN WATER SYSTEMS SHOULD GO PRIVATE,
S. H. Hanke.
Journal of the American Water Works Association, Vol 74, No 2, p 14, February, 1982.

Descriptors: *Economic aspects, Water supply, *Municipal water, Planning, Wastewater treatment, Water demand, Pricing, *Commercial water supply.

Urban water systems are faced with the problem of being unable to raise enough capital to properly maintain and expand their existing systems. The market value of nearly all private water companies is below book value and most municipal systems need repair and renovation. Price controls have caused the capital shortage in the industry. One solution to the capital shortage problem requires a federal subsidy or bail-out program. However, by further politicizing the provision of water a federal subsidy would create great inefficiencies and inequities. A second option involves removing price controls. This would put water purveyors on a self-financing basis in which users would pay the real costs of their water. It would remove the need for water conservation through nonprice rationing programs. Most importantly, it would improve the suppliers' ability to provide adequate, high-quality services. The most desirable way to accomplish price decontrol would be to privatize and deregulate the industry. France has used such a system for many years. (Baker-FRC)
W82-05436

HYDRO-ECONOMIC ANALYSIS AND PROJECTION OF IRRIGATION WATER DEMANDS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. F. Kibler, V. Crowley, R. L. Bartel, W. B. Detar, and E. L. White.
Report, April, 1981. 206 p, 44 Fig, 43 Tab, 66 Ref, 1 Plate, 5 Append.

Descriptors: *Irrigation efficiency, Crop yield, Soil moisture deficiency, *Projections, Model studies, *Water demand, Water stress, Economic justification, Economic yield, Economic prediction, Benefits, Hydrologic data collections, Hydrologic maps, Water allocation, Costs, Irrigation effects, River basins, *Pennsylvania, *Cost analysis.

A 1977 study of Pennsylvania's irrigation needs quantified potential water demands by crop and region by analyzing long-term soil moisture deficit. A more refined estimate of irrigation demand as it is affected by expected net returns to irrigation was desired. The objectives of this study were to: assess economic costs and benefits associated respectively with irrigation system costs and increased crop yield; evaluate new irrigation system and scheduling operations which are energy and water-efficient and that meet moisture-stress levels; project irrigation demand with water availability by DER river basin units; and map irrigable areas and potential water shortages in the DER river basins. A major finding of this study was that irrigation of moderate value cash crops, such as potatoes, is economically justified if irrigation can be applied near the optimal water-stress point for the crop. Net returns on profits will be highest under current economic conditions when higher cash value crops are irrigated with hand-moved, portable set irrigation systems at a trigger point of 0.40 FMD (fraction of moisture deplated). A second major finding involved determining a water shortage index for irrigation, i.e., the maximum acreage that can be irrigated under optimum conditions without depleting water supplies below the 2-year, 30-day drought level. A daily soil moisture model was used to compute moisture deficit in the crop rooting zone on a daily basis over the growing season. The model was then used to compute a seasonal water stress index (WSI). Yield increases above the no-irrigation policy were simulated for certain crops for the years 1948-1975. (Atkins-Omniplan)
W82-05558

ECONOMIC ANALYSIS OF WATER MAIN BREAKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W82-05673

AN APPLICATION OF MATHEMATICAL PROGRAMMING TO WATER RESOURCES PLANNING: AN ECONOMIC VIEW,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
For primary bibliographic entry see Field 6A.
W82-05737

BILLING DATA AIDS UTILITY PLANNING,
Arlington County Dept. of Public Works, VA. Public Works Planning.
N. K. Hook, Jr.
Water/Engineering and Management, Vol 129, No 3, p 42, 44, March, 1982. 1 Fig.

Descriptors: *Utilities, *Management planning, *Water demand, Pricing, Prices, Economic aspects, Computers.

A new utility billing system was developed in the early part of 1979 for Arlington County, Virginia, in response to the Industrial Cost Recovery requirements defined in Public Law 92-500. An interactive system with many more capabilities than the older computer assisted operation was put into use. The new system improves the responsiveness for assisting the customer with inquiries concerning the account; provides adjustments to the account; undertakes immediate updates to basic account data needed by customers moving, meter changes or other actions; issues bills within days rather than months due to improvements being made in meter reading procedures and data entry; and permits immediate access to all customer information, thereby minimizing manual research. Currently the county has eight major water pressure zones or service areas. To allow for future flexibility in the system, a two digit code was used, with the first digit describing the pressure zone and the second digit left as a zero for future use. A third numeric code describes the geographic sanitary sewershed. The Refuse Code describes refuse services provided to the account and facilities planning for refuse collection. Many utility systems currently have a billing system which may be capable of providing sophisticated data for use in utility planning purposes. If a new billing system is contemplated, incorporation of such a data base is cost effective in terms of information which will be needed at some future date. (Baker-FRC)
W82-05786

PRICE OR PERSUASION,
Idaho Univ., Moscow. Dept. of Economics.
J. T. Wenders.
Water/Engineering and Management, Vol 129, No 3, p 32-34 March, 1982. 2 Fig, 2 Tab.

Descriptors: *Pricing, *Water demand, Water supply, Water conservation, Economic aspects, Tucson, Arizona.

Events occurring in Tucson, Arizona during the 1970's provided an opportunity to investigate the potentials of two methods of controlling water consumption. The first method considered raising the price as a stimulant to conservation. The second method relies on persuading the consumers to consume less. In Tucson, significant price increases and publicity campaigns were both instituted to encourage water conservation during this period of time. Analysis of the results suggests that the decrease in water usage occurred in response to the price increase and that any decrease in response to persuasion was negligible. However, a Beat-the-Peak campaign aimed at reducing the use of water during the hottest periods of the day has achieved a 20% reduction in water consumption during these times. Even so the separate effect of the Beat-the-Peak program on water consumption was small and was clearly superseded by the effect of the price increase. (Baker-FRC)
W82-05791

CURRENT TRENDS IN COST OF SERVICE STUDIES,
Coffin and Richardson, Boston, MA.
V. F. Pennacchio.
Journal of the New England Water Works Association, Vol 96, No 1, p 55-60, 1982.

Descriptors: *Water rates, *Water costs, *Prices, Water meters, Marginal costs, Cost allocation, Peak demand, Water conservation, Subsidies, Utilities.

Several methods of determining water rates are described. In general the current trend appears to be toward the proven methods of the 1960's and early 1970's. These include the American Water Works Association Base-Extra Capacity Method, which sells no water at less than base cost and charges more for excess demands. If properly designed, this type of structure will result in fair and equitable rates for all customers. Some of the newer concepts in water rates are evaluated. Most marginal cost pricing theories as applied to utilities are actually incremental cost approaches and include long run costs. Problems with these methods are a difference between actual costs and the revenues computed, as well as difficulties in assuming that price is elastic when in fact domestic water prices are nearly inelastic. Demand-type rates (time-of-day metering, peak demand metering, and ratchet rates) can be fair, but recording consumption on a continuous basis is not economically feasible except for very large users. Some of these methods can also encourage heavy use and resultant increased sewage flows during off-season of off-peak hours. Although conservation-type rates, which penalize large users, discourage waste, they can also discourage industrial growth. Lifeline rates are intended to establish a low subsidized rate for a minimum quantity of service to help low income families. This is not fair because low quantity users, whether affluent or poor or on vacation, will receive the subsidy. (Cassar-FRC)
W82-05806

COLORADO RIVER WATER ALLOCATION,
Colorado River Board of California, Los Angeles.
M. B. Holburt.
Water Supply and Management, Vol 6, No 1-2, p 63-73, 1982. 5 Tab.

Descriptors: *River basin development, *Water rights, *Water supply development, *Colorado River, *Water law, *Salinity, Water resources development, River basins, River systems, Potential water supply, Available water, Riparian rights, Water quality control.

The states drained by the Colorado River System have tried to obtain for their citizens maximum use of the water resources from the river. The water supplies of this system are already 90% utilized, with full use of Colorado River waters expected within the 1980's. The 'Law of the River', which controls the apportioning of river waters, is composed of many interstate compacts, federal laws, water delivery contracts, state legislation, a treaty and other agreements with Republic of Mexico, a United States Supreme Court decision and federal

USDA-NAL, Ft. Collins, Colorado

administrative actions. By 1990, total water uses are expected to reach the dependable annual flow of 14 million acre feet. Since this figure is not as great as anticipated when the waters were apportioned, there is potential for serious future conflicts. Future water resource development projects will need to concentrate on meeting the obligations of the Mexican Water Treaty of 1973. Several salinity control measures must be enforced to ensure the quality of Colorado River water for Mexican and United States users as well. (Geiger-FRC)
W82-05888

6D. Water Demand

A NEW LOOK AT SMALL POWER PLANTS. 2. THE ENVIRONMENTAL EFFECTS,
California Univ., Berkeley.
D, B. Champion, and M. D. Williams.
Environment, Vol 22, No 3, p 25--32, April, 1980. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Environmental effects, *Powerplants, Electric powerplants, Water demand, Water supply, Water pollution, Water rights, *Comparison studies.

The Los Alamos Scientific Laboratory has conducted a study comparing the use of small coal-fired power plants with the use of large power plants for expanding electrical generating capacity in the Rocky Mountain West. The environmental aspects of constructing one 3000 megawatt power plant were compared with the environmental effects of three 500 megawatt and one 750 megawatt units; all units considered were proposed for construction in southeastern Utah. Water supply availability poses a significant problem in the construction of any coal-fired power plants, since in many cases the available supply is already fully used. Small plants would be more easily able to assemble the rights to surface water supplies by purchasing them from irrigators than would large plants. In either case, transferring water from irrigation to use by the power plants would have the beneficial effect of reducing irrigation return flows in the Colorado-Green River basin and salinity in the rivers. Since the power plants do not discharge waste water back to the rivers, no other significant water quality impacts would occur. It is concluded that although the cumulative impact of a series of smaller power plants might equal that of a large plant, the impact would be spread over a larger area and would therefore be more easily absorbed by the environment. (Caroll-FRC)
W82-04769

RECONSTRUCTION OF THE NORTHERN DONETS-DONBAS CANAL,
For primary bibliographic entry see Field 8A.
W82-04773

ICEBERGS: TECHNOLOGY FOR THE FUTURE,
Cambridge Univ. (England).
For primary bibliographic entry see Field 2C.
W82-04778

COMPETITION FOR WATER RESOURCES: COAL AND AGRICULTURE IN THE YELLOWSTONE BASIN,
Indiana Univ. at Bloomington.
T. D. Georgianna, and K. E. Haynes.
Economic Geography, Vol 57, No 3, p 225-237, July, 1981. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Water demand, *Forecasting, *Competing use, Water management, Resources management, Mathematical models, Optimization, Agriculture, Coal mining, Montana, *Yellowstone River basin.

The Yellowstone River Basin serves as an archtypical system in which to assess the competing demands made upon water resources by energy and agriculture. One method currently used for forecasting water demand in strip mining operations plots the relationship between water use in coal production and the amount of coal produced to approximate straight-line time series forecast. However, major assumptions underlying this methodology are shown to be false. An alternative scheme is presented which takes advantage of shadow pricing, permitting the formulation of a non-linear mathematical programming problem for the derivation of an optimal solution to the allocation of a limited resource among competing users. This formulation for minimizing the cost of water in an area where agriculture and coal production are in competition for limited water resources provides a workable formulation which yields information about the relationship between water uses in the two industries and about costs of water as incentives or disincentives for pollution. (Carroll-FRC)
W82-04805

NET ENERGY: RESULTS FOR SMALL-SCALE HYDROELECTRIC POWER AND SUMMARY OF EXISTING ANALYSES,
Energy Policy Studies, Inc., Omaha, NE.
M. W. Gilliland, J. M. Klopatek, and S. G. Hildebrand.
Energy, Vol 6, No 10, p 1029-1040, October, 1981. 7 Tab, 25 Ref.

Descriptors: *Powerplants, *Hydroelectric plants, *Economic efficiency, Energy conversion, Performance evaluation, *Dams, Retrofitting.

Net energy analysis is a potential tool for evaluating emerging energy technologies. A net energy analysis was performed for small scale hydroelectric power facilities to permit comparison with conventional hydroelectric plants and other technologies. The analysis was applied to seven projects based on retrofitting of existing dams, with powerplant capacities ranging from 1325 to 6500 kw. Unit capital costs ranged from $432 to $1488 per installed kw. Most of the power plants were to operate as run-of-the river facilities. Energy inputs were calculated as the sum of all primary energy required to construct and operate the plant. The net energy ratios of five of the seven facilities were remarkably consistent at 10-12:1. Thus the majority of small-scale hydroelectric retrofits should deliver 10-12 times more energy as electricity and 31-37 times more energy as fossil fuel equivalents than is required to build and operate them. Results were compared with conventional hydroelectric plants with capacities at least an order of magnitude larger than the small facilities. Net energy ratios for peak power dams were smaller than those for the small hydro facilities, while the ratio for the base-load examined was similar to the mean for the small-scale hydro facilities. These findings support the concept that substantial energy savings can be realized by making investments in retrofit of existing capital stocks. (Carroll-FRC)
W82-04806

WATER SUPPLY IN THE USSR.
Water Services, Vol 85, No 1029, p 568-569, 1981.

Descriptors: *Water supply development, *Water demand, *Potable water, Drinking water, Water supply, Water quality management, Water management, Water use, Consumptive use, Moscow, *USSR.

The 1981 to 1990 decade was declared the International Drinking Water Supply and Sanitation Decade by the UN General Assembly. Each individual in Moscow, on the average, consumes almost 700 liters of potable water daily. Most of the Soviet Union's freshwater flows to the Arctic Ocean and the Pacific in the scarcely populated areas of the country. The Soviet State Standard sets stringent demands on drinking water purity. Muscovities pay for part of the water they use, while the rest of the expenses are covered by the city's enterprises. Water supplies are fluorinated to comply with USSR legislation. Freshwater consumption is increasing rapidly and its use by factories is being restricted in some places. In deciding upon prices for water supply, the republican and local authorities are invariably trying to keep prices for household use as low as possible. Many establishments in the Soviet Union are studying the problems of water supply while the Main department of Water Protection of the USSR Ministry of Land Amelioration and Water Economy and local governments protect surface and underground water supplies. A new plan set forth in the Protection of the Environment section of the Guidelines for the Economic and Social Development of the USSR for 1981-1985 and for the Period Ending in 1990 intends to expand to use of recycled water, introduce more non-effluent closed-water circuits, and adopt water protection projects more quickly. (Geiger-FRC)
W82-04849

FRESH-WATER TRANSPORT BY SEA,
Oufresne and Henry Engineers, Inc., North Springfield, VT.
R. M. Dunlap.
Journal of Hydrology, Vol 51, No 1-4, p 313-318, May, 1981. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Water transport, *Ships, *Transportation, Water supply, Arid lands, *Icebergs.

Researchers have recently begun to study the feasibility of transporting icebergs to help meet the water needs of arid lands. As an alternative, it is suggested that a submerged, flexible water container pulled by a semi-submerged tug boat could be used to transport fresh water from regions of abundant fresh water or from the mouths of such rivers as the Amazon and the Rhone to arid lands accessible by sea transport. This sea transport system is composed of the container and its ballast, the tug and a tow cable, and the terminals. The proposed container is a non-circular flexible cylinder fabricated of multilayer polyester sheet and having the cross-sectional shape of a fish. This fresh-water container would have a capacity of 5,000,00 cubic meters. The specially-designed low-speed, semi-submerged, highly-efficient diesel-powered twin screw tug boat would pull the container with a commercially available nylon cable. Upon arrival at its destination, the container would be anchored and secured and connected to the water distribution system, serving as a reservoir for the fresh water. Several potential transport routes, ranging from 900 to 4.700 kilometers, are suggested. Total capital costs are estimated to be $50,650,000. The total transport cost is estimated at about $0.03 per ton per 1,000 kilometers. (Carroll-FRC)
W82-04861

WATER TO THE SOUTH-WESTERN CAPE KEEPING UP WITH THE DEMAND.
For primary bibliographic entry see Field 3C.
W82-04887

STRIPMINING ARID NAVAJO LANDS IN THE US: THREATS TO HEALTH AND HERITAGE,
J. Radford.
Ambio, Vol 11, No 1, p 9-14, 1982. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Strip mines, *Water supply, Environmental protection, Water rights, Aquifers, Water quality, Water reuse, *Water demand, *Chaco region, *New Mexico.

Massive strip mining operations in the Chaco region of New Mexico's San Juan Basin may accelerate desertification, deplete already scarce water supplies, undermine the Navajo Indian way of life, dramatically degrade air quality, and compromise fossil and archeological resources of world importance. With an average precipatation of 9 inches or less, the Chaco is the most arid of the 12 national coal production regions designated by the US Department of Energy. The scarcity of water has important implications for the land's reclamation potential after stripmining, although current laws require that stripmined land be returned to its previous productive capacity or better. Total precipitation in the form of snow averages only 1.82 inches during a typical winter. Under certain conditions snow fences could help protect seeded areas from the Chaco's strong winds, but in any event this is considered a very expensive method

for widespread usage. Surface water and shallow aquifers cannot begin to meet the expected water demand in this area of the country. Alternative sources being considered include diverting water about 40 miles from the San Juan River to the north, drilling deep wells at numerous locations in the Chaco, and re-using water pumped out of uranium mines to the south. Use of the river water is highly contested, with the Native Americans claiming that their treaty rights to water are already abridged by over-allocations. (Baker-FRC)
W82-05036

WATER SYSTEM DESIGN MEETS MODERN CHALLENGES,
Watson and Co., Tampa, FL.
For primary bibliographic entry see Field 5F.
W82-05170

ABANDONED COAL MINES IN WEST VIRGINIA AS SOURCES OF WATER SUPPLIES,
West Virginia Geological and Economic Survey, Morgantown.
For primary bibliographic entry see Field 3C.
W82-05219

WATER USE IN OHIO, 1975,
Geological Survey, Columbus, OH. Water Resources Div.
R. M. Hathaway, and M. Eberle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-192980, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-17, 1981. 43 p, 6 fig, 7 Tab, 41 Ref.

Descriptors: *Water use, *Water supply, Surface water, Groundwater, Thermal powerplants, Industrial water, Municipal water, Livestock, Irrigation water, *Ohio, Water demand.

The estimated water use in Ohio for all purposes in 1975 was 16,431 million gallons per day. Of this total, 15,321 were taken from surface water while the remaining 1,110 represent ground-water withdrawals. Totals by category are as follows (in million gallons per day): Thermoelectric power generation, 12,404; self-supplied industrial use, 2,362: public water supplies, 1,423; rural domestic and livestock, 201; and irrigation, 40. Per capita water use was calculated to be 1,528 gallons per day for an Ohio population of 10,751,000 in 1975. Jefferson County led all Ohio counties in total water use with 3,447 million gallons per day. This was nearly three times the usage of second-ranking Gallia County where withdrawals were 1,242 million gallons per day. The heavy water use in both of these Ohio River counties is due to large withdrawals for thermoelectic power generation. Cuyahoga, Lorain, and Lake Counties, all in the Cleveland metropolitan area, rank third, fourth, and fifth in the State with respective totals of 1,061, 1,047, and 1,030 million gallons per day. Water use is more diverse in this area, with public supplies, industrial use, and thermoelectric power all making significant impacts. (USGS)
W82-05226

WATER RESOURCES OF THE WALKER RIVER INDIAN RESERVATION, WEST-CENTRAL NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-05235

RIVER BASINS AND WATER MANAGEMENT IN NEW BRUNSWICK,
New Brunswick Dept. of Fisheries and Environment, Fredericton.
W. F. G. Cardy.
Canadian Water Resources Journal, Vol 6, No 4, p 66-79, 1981. 1 Fig, 3 Ref.

Descriptors: *Water management, *Planning, *New Brunswick, Water pollution control, River basins, Public participation, Administration, *Water policy, St. John River, Water resources development, Canada.

New Brunswick has abundant water, a small population, and little perceived need for water management. Sufficient water is available for use as well as for wastewater dilution in the river basins, but the coastal plains using limited groundwater are experiencing occasional shortages. Management activities have generally been on a provincial scale. A major planning exercise took place in the St. Johns River Basin during 1970-74. Comprehensive reports and 30 specialist reports were issued. A framework for water management with eight levels of decision was established. Implementation of the plan has been slow for three reasons: (1) the question of whether a comprehensive study was necessary when the major pollution arose from only a few well-identified sources, (2) changes were not suggested, but people were encouraged to find the solution themselves, and (3) loose administration and changing governmental policies. The study did, however, arouse public interest and discussion about the pollution problems. At present there is no need for further basin-wide planning in New Brunswick. Strategy should be directed toward solving problems on the local level as the needs arise. (Cassar-FRC)
W82-05391

COLD LAKE-BEAVER RIVER REGIONAL WATER RESOURCES STUDY,
Department of the Environment (Edmonton).
B. MacLock, and R. Hicks.
Canadian Water Resources Journal, Vol 6, No 4, p 119-140, 1981. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Oil shale, *Water demand, *Water management, *Planning, *Alberta, Cold lakes, Beaver River, Water pollution sources, Water use, Water quality, Decision making, Water resources development, River basins, Water allocation, Canada.

The Cold Lake-Beaver River Regional Resources Study was initiated in 1980 to develop a framework plan for the long-term management of the region's water resources. Within these basins are both vast oil sands deposits, extractable only by in situ mining, and a large percentage of the province's recreation and fishing lakes. Potential conflicts exist between these two uses. Specific study objectives were developed as part of a framework plan for long-term water management. From the objectives was formulated a study framework with 10 components: management issues, water supply (quantity, quality, and groundwater), water use, legal aspects, modelling, goals, management alternatives, public participation, synthesis and evaluation and plan formulation. Some of the obstacles in meeting the study objectives are: limited hydrometric and atmospheric data, uncertain water withdrawal forecasts for oil sands development, and lack of data in the instream fisheries field. The study will be undertaken in 4 phases over a 3.5 year period. (Cassar-FRC)
W82-05396

THE INTERACTION BETWEEN WATER SCARCITY AND WATER QUALITY DEGRADATION: ISRAEL AS A CASE STUDY,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
H. I. Shuval.
Water Science and Technology, Vol 14, No 1/2, p 453-463, 1982. 3 Fig, 5 Tab.

Descriptors: *Water management, *Water policy, *Water scarcity, *Israel, Desalination, Political aspects, Chlorides, Nitrates, Planning, Water reuse, Agriculture, Irrigation, Saline water intrusion, Eutrophication, Water shortage, Lake Kinneret, Semiarid lands, Water consumption, Wastewater irrigation, *Water demand, Coastal aquifers, Aquifers, Groundwater.

Israel is faced with severe water shortages and increasing degradation of water quality. Actual water consumption in 1981 was 1700 million cu m, using all the 1500 million cu m per year of replenishable fresh water and 200 million cu m per year of reused, brackish water or unreplenishable groundwater. By 2000 there may be a gap between demand and supply of 500 million cu m per yeat. About 25% of Israel's water resources are threatened by saline water instrusion into the coastal aquifer. The most effective remedy is reducing groundwater exploitation by half. Other schemes, diversion of Lake Kinneret water and shifting the site of groundwater exploitation, only delay the harmful effects for another generation to handle. Nitrates derived from human sources, have been increasing in water supplies at the rate of 1.35 mg per year. An effective strategy to combat nitrate pollution is 50% reduction in fertilizer application, tertiary treatment of all wastewater used for agricultural irrigation, and temporary groundwater recharge and exchange. Although wastewater reuse can help alleviate water scarcity problems, it causes its own difficulties--a burden of toxic chemicals and pathogens and disposal of effluents during the non-irrigation period. A practical scheme is to recycle treated wastewater for agricultural and industrial use, saving the highest quality water for domestic use. Desalination of seawater, included in many forecasts for 2000, is not economically feasible. (Cassar-FRC)
W82-05421

PROBLEMS OF THE MULTIPURPOSE USE OF WATER RESOURCES OF THE VOLGA-AKHTUBA FLOODPLAIN AND VOLGA DELTA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 4A.
W82-05487

INTEGRATED WATER MANAGEMENT: SOME INTERNATIONAL DIMENSIONS,
Biswas and Associates, Ltd., Ottawa (Ontario).
A. K. Biswas.
Journal of Hydrology, Vol 51, No 1-4, p 369-379, May, 1981. 6 Tab.

Descriptors: *Water management, *Water supply development, Resources management, Social aspects, Environmental policy, Projections, Hydroelectric power, Agriculture, Developing Countries.

The continuing increase in world population and the rising standard of living throughout the world will result in demands for more and more water supplies to meet basic human needs. The global picture with respect to water use and availability is very uneven. A 1976 survey of developing countries showed that only 35% of the people in these countries had adequate water supply and sewerage services. In the rural areas of many countries, less than 5% of the people have access to safe water. Water is essential for agriculture, and the total area under irrigation must be increased if the world food crisis is to be solved. In addition, better use must be made of irrigation water. Industry is a major user of water resources. In the United States, industrial demand accounts for about 40% of total water requirements. In addition, industrial users discharge large amounts of industrial wastes to water systems. The effects of expanding industrial development in third world countries on water resources will depend on the availability of water supplies and on water quality and wastewater regulations set by these countries. While hydropower resources have been extensively developed in North America and Europe, there is a vast, unexploited potential in Africa, Asia, and Latin America. More attention needs to be focussed on the social and environmental implications of water development, particularly in developing countries. It is concluded that the question of the availability of adequate water to sustain future world population and development over the next two decades is primarily one of instituting rational management practice. (Carroll-FRC)
W82-05493

COSTA RICA STAYS TOP OF WATER LEAGUE,
World Water, Vol 5, No 2, p 14-15, February, 1982. 5 Fig.

Descriptors: *Water resources development, *Water demand, Costa Rica, Latin America,

Water supply, Reservoirs, Wastewater treatment, Drinking water.

Costa Rica is well ahead of other Latin American countries in terms of water supply and waste disposal, with 98% of the urban population receiving safe water and 61% in rural areas. For waste disposal, systems are available to 96% of the urban population and 86% of the country dwellers, although many of them involve discharge of untreated wastes into the rivers. The modern story began with the foundation of the Instituto Costarricense de Acuaductos y Alcantarillados (AyA) to deal with a water crisis at the beginning of the 1960s which greq out of the inabilities of individual municipalities making up the city and environs to cope with growing demands. AyA devoted most of its first 20 years to the task of establishing its own organization and providing for the various systems that had previously supplied districts in the capital and other areas. Large portions of the national budget were channeled into sanitation and water supply. The recently completed second phase of the AyA operations has been the replacement of much of the old network in the San Jose area and construction of certain key elements in the overall scheme after emergency work and a chlorine injection and pumping plant at Puente de Mulas and distribution systems for the whole area. With the effective completion of Phase 2 of the supply plan, AyA sought and secured from the British government assistance in the preparation of a mathematical model to determine the overall efficiency of the system to provide data for progress on Phase 3. A mathematical model is being devised which can be updated to grow with the progression of additional networks and the improvement of existing ones. (Baker-FRC)
W82-05500

HYDRO-ECONOMIC ANALYSIS AND PROJECTION OF IRRIGATION WATER DEMANDS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 6C.
W82-05558

THE NILE WATERS: SUDAN'S CRITICAL RESOURCE, PART II,
Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.
H. Dickinson, and K. F. Wedgwood.
International Water Power and Dam Construction, Vol 34, No 2, p 31-34, February, 1982. 24 Ref.

Descriptors: *Water resources development, *Planning, Sudan, Irrigation, Agriculture, Jonglei project, Nile River, Dams.

Major dams on the Blue Nile and the Atbara have succeeded in making better use of what were formerly seasonal waters, but the ecological impact of the Roseires dam has yet to be fully evaluated. The 1959 Nile Waters Agreement has been of benefit to Sudan, as has the development of rain-fed and underground-water-fed agriculture which play an important role in that country. However, the quantity of water from these later sources is small in relation to the contribution of the Nile river system. The growth of agriculture based on irrigation in Sudan is likely to be restricted by the provisions of the Nile Waters Agreement. Its cost is high and the risks involved in reducing the water entering the Sudd are also to be considered. To minimize these risks an extensive research program has been undertaken. Much of the environmental and ecological work is directed toward filed surveys, and the data collected will provide valuable base material against which the effects of the Jonglei canal may be judged. The energy-intensive desalination of water taken from the Red Sea is an option open to Sudan only if major oil finds should occur in the country. At present, therefore, even if the Jonglei project is successful in providing Sudan with a further annual supply of 3 or 4 billion cubic meters of water, it will only delay the time when further conventional agricultural development will be impossible without new water resources. (Baker-FRC)
W82-05601

LARGE WATER AND HYDROELECTRIC DEVELOPMENTS IN FIJI,
H. Bandler.
Search, Vol 13, No 1/2, p 26-30, February/March, 1982. 7 Fig, 1 Tab, 2 Ref.

Descriptors: *Water resources development, *Construction, Dams, Fiji Islands, Economic aspects, Powerplants, Hydroelectric plants, Hydroelectric power.

The construction of Vaturu Dam and the associated works of the Nadi and Lautoka Regional Water Supply Scheme will supply high quality drinking water to a great number of Fijians and their visitors. The Monasavu-Wailoa Power Project will save the country millions of dollars with its integrated power grid and the generation of hydroelectric power. Both of these large, complex projects will assist in making the country self-reliant. Carried out in situations where great natural obstacles were encountered, they are technical achievements in which expertise and knowledge has been gained which will facilitate further development of the water resources of Fiji. The dams are leading examples of modern construction. Although expatriate engineering staff is largely involved, considerable local skill has been demonstrated by technical and professional employees. The hydroelectric plant will significantly reduce the need for imported oil. (Baker-FRC)
W82-05614

WATER SUPPLY FOR NEW YORK CITY IN THE 1980S,
Olympia and York Battery Park Co., New York.
F. X. McArdle.
Journal of the American Water Works Association, Vol 74, No 3, p 137-139, March, 1982.

Descriptors: *Water supply, *Urban areas, *Water management,*New York City, Water quality, Water distribution, Financng Reliability, Metropolitan water management, Water treatment, Water demand, Water consumption, Capital costs, Maintenance, Drinking water, Drought.

New York City's water system faces problems of providing sufficient quantities, maintaining high quality, ensuring reliability of supply, and financing capital needs. Although the city's population has not grown, water demand has increased with the installation of more air conditioning and home appliances. It is unknown whether demands will continue to increase, in which case new water sources must be sought. In the short term, droughts will periodically force reductions in consumption. The lack of widespread metering in the city is a hindrance in water management during a period of shortage. New York's protected watersheds have provided raw water requiring only disinfection, fluoride, and algae control. Increased development in Westchester and Putnam counties necessitated construction of a $250 million filtration plant in the Croton system. Another water quality issue involves the use and disposal of toxic chemicals within the watersheds. To ensure reliability of the main system over $100 million must be spent in the next 10 years to maintain dams properly. A third water tunnel is expected to reach completion by 1990. The 10,720 km distribution system suffers from frequent breaks, at least two major ones per day. Most failures are a result of disturbances by traffic and subways. A 3-year program is designed to replace 38 km of Manhattan's 150 mm pipe to reduce breaks by 20% per year. Financing replacement and new facilities is difficult for large, older cities. It is hoped that the present capital replacement program can be maintained over the long term in spite of institutional strictures imposed by the state constitution. Unless the cities solve problems of quantity, quality, reliability, and financing in their drinking water system they face continual decline and disintegration. (Cassar-FRC)
W82-05671

COMPARING TWO MEASURES OF WATER BASED RECREATION PARTICIPATION,
Wisconsin Univ.-Madison. Dept. of Forestry.
J. H. Gramann, and R. J. Burdge.
Water Resources Bulletin, Vol 18, No 2, p 339-341, April, 1982. 1 Tab, 4 Ref.

Descriptors: *Recreation, *Surveys, *Public participation, Lakes, Boating, Fishing, Public waters, Swimming, Fishing.

Two methods of measuring participation at water based recreation sites were compared at Lake Shelbyville, Illinois. Respondents were asked to name the main recreation activity in which they participated at the reservoir during an entry point interview and then by a questionnaire mailed to the home. The percentages of persons specifying the same main activity in both types of surveys were: boat fishing, 91.4; water skiing, 81.0; shore fishing, 74.0; power boating, 65.3; swimming, 60.4; and relaxing, 37.5. Inconsistencies were most common in activities which overlapped (power boating, water skiing, and boat fishing) and in generalized activities (relaxing). In general either method or combinations of both methods can provide reasonably unbiased measures of water based recreational use. (Cassar-FRC)
W82-05733

MODELING OF WATER SUPPLY/DEMAND IN THE SOUTH PLATTE RIVER BASIN, 1970-2020,
Colorado State Univ., Fort Collins. Engineering Research Center.
D. W. Hendricks, B. A. Janonis, S. Gerlek, J. C. Goldbach, and J. L. Patterson.
Water Resources Bulletin, Vol 18, No 2, p 279-287, April, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Water supply, *Water demand, *Hydrologic budget, South Platte River Basin, *Colorado, Model studies, Water conservation, Planning, Long-term planning, Systems analysis, Water storage, Forecasting, Drought, Irrigation, Water reuse, Water transfer.

A water balance model was applied to the South Platte River Basin, Colorado, to determine solutions to the supply/demand problem for both average andd stress conditions for the years 1980, 2000, and 2020. The base year was 1970. The model was displayed in tabular form on 8ft x 8ft color-coded magnetic board. Solutions obtained for different conditions were produced for evalution by different interest groups. Some of the information obtained from this model as applied to the South Platte Basin included: the present per capita water use of 220 gpcd could be reduced to 167 gpcd without severe difficulties, an additional 280,000 acre feet could be imported from the Colorado River basin with minimum social and economic disruption, the potential role of large-scale water exchanges between urban and agricultural users should be explored, water reuse is necessary, irrigated acreage can be adjusted to the amount of available water, and increased storage facilities would capture excess flows. (Cassar-FRC)
W82-05738

MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,
Policy Sciences Associates, Boulder, CO.
For primary bibliographic entry see Field 3D.
W82-05748

THE EIGHTIES--IMPLICATIONS FOR WATER MANAGEMENT,
Ministry of State for Economic Development, Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W82-05772

DEVELOPMENT ISSUES IN THE COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 3-10, 1982.

Descriptors: *Water rights, *Colorado River, *Water resources development, *Water supply de-

velopment, *Water allocation, *Irrigation practices, River basins, Water management, Resources management, Irrigation water, Irrigation-return flow, Available water, Salinity.

An overview of the historical settlement of the Colorado River Basin, its economic growth and water and energy development, and prospects for meeting future resource needs is presented. Mexico is already using its full entitlement of water from the river, while the Lower Basin will reach its maximum allowable usage in just a few years with the completion of the Central Arizona Project in the 1980's. The upper Basin has developed about two-thirds of its entitlement and must make many serious water allocation decisions before full development. Energy development and allocation of water to adjoining basins for urban growth are major considerations in the Upper Colorado River Basin. The Lower Basin is facing similar problems as its population increases. Salinity levels must be kept to a minimum to ensure maximum utility of available water supplies. This is done most effectively by on-farm irrigation projects. Water rights decisions for Indian reservations will play a significant role in the future development of the Colorado River Basin. (Geiger-FRC)
W82-05890

THE PHYSICAL ENVIRONMENT OF THE COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 11-27, 1982. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Water resources development, *Water supply development, *Colorado River, *Available water, *Resource development, *Groundwater mining, Water management, Groundwater management, Water use, Irrigation water, Recreation, Coal mining, Groundwater recharge, Land use, Geomorphology, Climates.

Some of the physical features, climatic conditions, water resources, land use, and scenic and recreational resources of the Upper and Lower Colorado River Basin are examined along the energy resource developments along this river basin. Water supplies of the basin are utilized heavily; about 30% of the water supply is exported to adjoining basins to serve primarily metropolitan areas. Approximately 15 million acre-feet of water originate in the Upper Basin, while 3 million acre-feet come from the Lower Basin. The Lower Basin states are now using nearly all of their entitlement to surface water supplies from the basin and mining groundwater for municipal, agricultural and industrial use at a rate faster than natural recharge rates. States of the Upper Colorado Basin have not fully utilized their entitlement and mine groundwater principally for industrial and municipal use. About 50% of the potential hydroelectric power of the basin has already been developed. The mining of uranium, coal, and shale oil in the Colorado basin will also create new water needs. (Geiger-FRC)
W82-05891

6E. Water Law and Institutions

TOWN OF DE BEQUE V. ENEWOLD: CONDITIONAL WATER RIGHTS AND SATUTORY WATER LAW,
M. Hope.
Denver Law Journal, Vol 58, No 4, p 837-845, 1981. 78 Ref.

Descriptors: *Water rights, *Water law, *Colorado, *State jurisdiction, Water management, Water allocation, Legal aspects, Land rights, Land tenure, Appripriation, Water use.

In the past history of Colorado water law, an opposing party bore the onus of challenging a conditional water right in court. As a result of the decisions of De Beque vs. Enewold and other recent water rights cases of the Colorado Supreme Court, the burden of successfully maintaining a conditional water right through strict compliance with the statute is now upon the holder. A conditional water right may expire after a certain lapse of time under section 37-92-301 of the Colorado Water Rights Determination Act of 1969 if the holder does not obtrain and file an application for a reasonable finding of beneficial use of the water as required by section 37-92-601 of the law. In 1975, an amendment to the 1969 Water Act, section 37-92--305, alleviated some of the pressure on the holder by requiring the court to give notice prior to the cancellation or expiration of a conditional water right. The significance of the decision, however, lies beyond the holding of the De Beque case, which exemplified strict interpretation of statutory water law and the court's deference to the lawmaking function of the general assembly. (Geiger-FRC)
W82-04801

BRYANT V. YELLEN: PERFECTED RIGHTS ACQUIRE NEW STATUS UNDER A BELATED CLARIFICATION OF ARIZONA V. CALIFORNIA,
J. D. Carver, and C. L. Kramlich.
Denver Law journal, Vol 58, No 4, p 847-860, 1981. 137 Ref.

Descriptors: *Water rights, *Irrigation districts, *Land tenure, *Reclaimed water, *Legal aspects, Water law, Irrigation water, State jurisdiction, Water allocation, Water reuse, Reclamation, Water use, Water demand, *Imperial Valley, California, Arizona.

The Federal Reclamation Act of 1902 states that single owner land holdings of 160 acres or less are ineligible for the delivery of reclamation water for irrigation purposes. This restriction and a residency requirement were included in the law to promote widespread land ownership and a more equitable distribution of federal benefits. Section 46 of the 1926 Omnibus Adjustment Act empowers the Secretary of the Interior to deny water to any landowner who refuses to dispose of his land in excess of 160 acres. In 1929, the Boulder Canyon Project Act was drawn up to allow the Imperial Valley to receive water from a reclamation project. In 1932, the Imperial Dam and All-American Canal were constructed. Some landowners in the Imperial Valley with vested water rights were declared immune from the 160-acre limitation law by the Project Act. The Bryant vs. Yellen court case signaled a change in the Supreme Court's position toward resolving conflicts between federal and state law over the delivery of reclamation water. By upholding the present perfected water rights, the court managed to avoid the controversial issue of reclamation policy which might be better addressed by Congress. (Geiger-FRC)
W82-04802

OIL SHALE AND WATER QUALITY: THE COLORADO PHOSPECTUS UNDER FEDERAL, STATE, AND INTERNATIONAL LAW,
Denver Univ., CO.
P. S. Dempsey.
Denver Law Journal, Vol 58, No 4, p 715-749, 1981. 244 Ref.

Descriptors: *Oil shale, *Legal aspects, Resources development, Water law, Legal review, Legislation, Water pollution, Environmental protection, *Water pollution control, *Colorado.

This article reviews the different levels of water pollution regulations and explores whether the United States' domestic oil shale reserves can be developed in a manner that not only promotes national energy policy but also accords with national environmental policy. An overview of the potential for water pollution associated with oil shale development is offered. The Federal regulatory scheme is discussed with emphasis on the federal water pollution contol act, including the National Pollutant Discharge limination System (NPDES) permit program and the dredge or fill permit program; the resource conservation and recovery act, including the hazardous waste management program and the solid waste disposal program; the safe drinking water act; and the effect of a federal permit. The Colorado Regulatory Scheme is discussed, including the state administration of the NPDES, RCRA, UIC, and section 404 programs; water quality protection via other means; water quality regulation and water rights; and federal preemption. The international environmental regime between the United States and Mexico is considered emphasizing the effect of the 1944 treaty between the countries in that the treaty does not specifically address water quality but does implicitly address it. The conventional and customary legal regimes are considered including the effect of United States Federal Precedent, International precedent, and the effect of customary international law. (Baker-FRC)
W82-04803

NON-INDIAN FEDERAL RESERVED WATER RIGHTS,
Hall and Evans, Denver, CO.
S. L. Waring, and K. S. Samelson.
Denver Law Journal, Vol 58, No 4, 783-799, 1981. 160 Ref.

Descriptors: *Reservation doctrine, *Water rights, Legal aspects, Water supply, Legal review, Legislation, Water law, Federal jurisdiction, State jurisdiction, Jurisdiction, *Montana.

The purpose of this article is to examine the extension of the Winters doctrine to non-Indian federal reservations and to consider some of the legal issues associated with this extension. Under the Winters doctrine, the United States Supreme Court determined that acquisition of the water rights for the Fort Balknap Indian Reservation was not governed by state law. Various types of Federal reservations and their sources of authorization are described, with a discussion of the applicability of the federal reserved water rights doctrine to each reservation. Special attention is given to a 1979 opinion of the Solicitor of the Department of the Interior, as this document represents the most comprehensive statement made by the Solicitor on federal reserved water rights. Recent trends and developments, however, suggest the declining fortunes of the doctrine of federal reserved water rights concludes. Many of the ambiguities of the reserved water rights doctrine will not be settled until they arise in the context of litigation. Congress has not enacted any legislation dealing explicitly with the reserved water rights doctrine. In contrast to congressional and executive inactivity, the Supreme Court limited the reserved water rights doctrine in the Mimbres decision, wherein the Court's restriction of reserved water rights to the primary purposes for which a particular reservation was originally created occurred even though Congress later enacted legislation expanding the purposes for which the reservation may be administered. This decision may mark the beginning of a trend toward a narrow construction of the reserved water rights doctrine and a step toward state control over water resources. (Baker-FRC)
W82-04804

GROUNDWATER MONITORING,
J. Josephson.
Environmental Science and Technology, Vol 15, No 9, p 993-996, September, 1981. 2 Fig.

Descriptors: *Groundwater, *Monitoring, *Water quality, *Groundwater pollution, *Legislation, Measuring techniques, Water sampling.

It has been predicted that Federal legislation enacted during the last decade will result in the drilling and installation of over one million wells designed to monitor potential sources of groundwater pollution. Samples representative of aquifer conditions should be obtained in such a way that their chemical integrity is preserved to the fullest extent possible. Multilevel point sampling or other multilevel instruments amenable to use with individual positive-displacement pumping systems should be used for sample collection. Filtering and processing of the samples should be conducted in such a way that no volatiles are lost and that no change in pH, metal, or other oxidation-reduction sensitive constituents occurs. Oxygen invasion of

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the sample must be avoided. A very detailed knowledge of the particular geologic and hydrologic formations and variables involved is essential to groundwater monitoring when the aquifer medium is porous carbonate rock. It may be advisable in many cases to run a geophysical survey to map aquifer size, shape, flow, and composition of the porous and impermeable media prior to the drilling of wells for monitoring. (Carroll-FRC)
W82-04809

SOME EMERGING RIGHTS IN AGRICULTURAL LAND,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden.
American Journal of Agricultural Economics, Vol 64, No 1, p 19-27, February, 1982. 36 Ref.

Descriptors: *Pollution control, *Legal aspects, Conservation, Wetlands, Land use, Water use, *Property rights, Economic aspects, Farming, *Agriculture.

A framework is set forth within which present reform efforts for soil conservation, nonpoint pollution control, wetlands protection and farmland preservation may be understood and from which flow implications for changes which are appropriate according to legal and economic criteria can be examined. In general society is well served by the liberal allocation of rights to farmland owners. The costs of monitoring and enforcing other arrangements would be prohibitive. Exceptions to this pattern are likely to occur where relatively little, easily identified land is involved, as with wetlands regulation. Much more change is apparent in the rules governing the exchange of rights. Where a reallocation of rights in response to new problems would be too costly or inconsistent with prevailing judicial sentiments, liability protections are attached to individuals' rights. This provides a mechanism by which the public interest can be served while providing fair compensation to owners whose rights are exchanged by fiat. It retains the flexibility of individual ownership and is consistent with the national ethic of maximum individual liberties consistent with the general welfare. (Baker-FRC)
W82-04890

ARIZONA GROUND-WATER REFORM: INNOVATIONS IN STATE WATER POLICY,
Arizona Univ., Tucson. Dept. of Political Science.
S. Hansen, and F. Marsh.
Ground Water, Vol, 20, No 1, p 67-72, 1982. 15 Ref.

Descriptors: *Water law, *Water policy, *Arizona, *Groundwater management, *Political aspects, *State jurisdiction, Economic aspects, Groundwater mining, Appropriation, Legal aspects, Judicial decisions, Administrative decisions, Water management, Groundwater depletion, Water rights, Policy making.

The major political forces in instituting reforms in Arizona groundwater law are described. Arizona groundwater policy is embodied mainly within the 1980 Groundwater Management Act. This legislation arose from Federal threats affecting a major reclamation project, special interest group pressures resulting from a 1976 decision restricting the transportation of ground water by municipal and industrial users, and the exploitation of groundwater causing dwindling supplies. The reform was achieved through structural decisions which delegated allocative decisions to the special interests directly affected by the ultimate policy. After basic decision costs had been incurred, the initiative was then ratified by the legislature in subsequent legislation without the need for the usual high legislative process costs. A Department of Water Resources was established by the 1980 Act which will be funded by a pump tax in addition to legislative appropriations. The Arizona Groundwater Management Act will only be as strong as it is flexible to handle economic, legal, and political shifts of the state through appropriate amendments in the future. (Geiger-FRC)
W82-04933

INSTITUTIONAL OBSTACLES TO WATER REUSE IN THE WESTERN UNITED STATES,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-04958

STRIPMINING ARID NAVAJO LANDS IN THE US: THREATS TO HEALTH AND HERITAGE,
For primary bibliographic entry see Field 6D.
W82-05036

CONSEQUENCES AND RESPONSIBILITIES IN DROUGHT FORECASTING: THE CASE OF YAKIMA, 1977,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2E.
W82-05082

ACID RAIN: LEGAL AND POLITICAL FALLOUT,
ERT, Concord, MA.
M. R. Deland.
Environmental Science and Technology, Vol 16, No 1, p 27A, January, 1982.

Descriptors: *Acid rain, *Political aspects, *Legal aspects, Air pollution, Regulations, State jurisdiction, Public rights.

Acid precipitation presents a variety of legal and political problems. Many of the traditional mechanisms for environmental regulation are ineffective in dealing with acid rain, since pollutants originating in one area may result in acid rain in a far distant area which may be in another state, region, or even country. Efforts by the northeastern states to seek redress under the Interstate Pollution Abatement section of the Clean Air Act have met with extended delays within the Environmental Protection Administration. Several states have also filed suit in U.S. Circuit Courts of Appeals. These cases have not yet been resolved. Formal negotiations with Canada regarding acid rain have not resulted in agreement on this matter. A variety of legislative initiatives address acid rain either directly or indirectly and vary significantly in both the limitations on contributing pollutants and the enforcement remedies. There is significant disagreement regarding the effectiveness of the proposed measures in limiting acid rain, and many parties are suggesting further investigations before any action is taken. (Carroll-FRC)
W82-05147

NATIONAL WATER POLICY: THE NEED FOR INSTITUTIONAL REFORM,
Library of Congress, Washington, DC.
W. Viessman, Jr.
Environmental Management, Vol 6, No 1, p 35-41, January, 1982. 13 Ref.

Descriptors: *Water policy, *Resources development, Public policy, *United States, Water resources development.

The importance of modernizing and simplifying the United States' water management program on the national level has been reviewed. Since the early part of this century, over 20 commissions or committees have labored to identify water problems, evaluate the availability of water and consider new directions in water policy. Many of these efforts have been relegated to library shelves, and there is little to show from the work which went into them. This is explained in part by the fact that few of these reports acquired a strong political constituency. One major exception to the rule was the 1069 study by the Senate Select Committee on Water Resources. Only five general recommendations were made by this committee, but most of these saw legislative action. The Water Resources Council, the Office of Water Research and Technology, and the periodic national water resources assessment process are products of the work of that committee. The performance record of the committee was unusually good, due mostly to its Congressional membership which had the political strength to ensure that its findings would receive the attention of the Congress. Effective policy reform is considered urgently needed if this country is to avoid a major water crisis. (Baker-FRC)
W82-05180

IMPACT OF AMERICAN REGULATIONS ON INDUSTRIAL SLUDGE MANAGEMENT,
Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. Zenz, and D. Lordi.
Effluent and Water Treatment Journal, Vol 21, No 12, p 547-554, December, 1981. 12 Tab, 21 Ref.

Descriptors: *Industrial wastes, *Waste management, *Legal aspects, Political aspects, State jurisdiction, Federal jurisdiction, Wastewater management, Wastewater treatment, *Illinois, Regulations.

Federal, state, and local governments developed a variety of laws and regulations pertaining to the management of industrial waste residuals during the 1970s. Federal regulations pertaining to hazardous waste management and to the management of industrial wastes generally are reviewed. Illinois water pollution control legislation and solid waste management programs are reviewed as an example of state initiatives. Ordinances of the Metropolitan Sanitary District of Greater Chicago are used to illustrate local regulations. The two main sets of Federal regulations affecting industrial wastewaters are the Pretreatment Regulations, which govern the control of industrial wastes introduced into publicly-owned treatment works, and the Hazardous Waste Management System Regulations. Illinois regulates the disposal of industrial wastes through a program which requires the operator of a disposal site to obtain an additional permit for each type of industrial waste accepted and through the special waste hauling manifest program, which permits tracking of industrial wastes from their generation to final disposal by means of a permit and manifest system. The Chicago sanitary district regulates industrial wastes through concentration limits for 14 contaminants and limiting conditions for the discharge of industrial waste to the sanitary sewer system. Implementation of the Federal Resource Conservation and Recovery Act is expected to result in a reduction in groundwater pollution, a reduction in hazardous waste dumping, and shifting of the cost of hazardous waste disposal from the taxpayer to the industry. The costs for disposal of hazardous wastes may increase, and there may be a shortage of available disposal sites. However, many hazardous industrial wastes are disposed on site, exempting them from close scrutiny. (Carroll-FRC)
W82-05184

A CASE STUDY OF RURAL OPPOSITION TOWARD RIVER VALLEY PLANNING,
W. Bolstad, B. Mathur, and H. MacKnight.
Canadian Water Resources Journal, Vol 6, No 4, p 141-156, 1981. 3 Fig, 4 Ref.

Descriptors: *Water management, *Public opinion, *Rural areas, *Meewasin Valley Authority, *Saskatchewan, Public relations, Public participation, Recreation, Social aspects, South Saskatchewan River, Saskatoon, Water policy, Water law, Water resource development, River basins, Canada.

The Meewasin Valley Authority, established in October 1979 to protect and develop the South Saskatchewan River Valley's resources for recreational and other purposes, met opposition from the rural constituency soon after its organization. Initial opposition was from realtors and others with interests in land. The River Edge Heritage Association became the nucleus of the dissenters, who gained considerable political power. Several mistakes fueled the controversy. Committee members were not well informed about the objectives of the Authority prior to the planning process. As work progressed some realized they did not agree with the objectives. Of the public interest groups invited to praticipate in planning, none represented the rural interests. This was not a purposeful omission, but planners did not know that rural areas are rarely represented by well-organized interest

groups. The conceptual plan had not been based on recreational demand studies and included in the natural system jurisdiction much land for which there were no plans. As a result of public opposition the Authority's Act was amended and some powers were removed and diluted. An appeal mechanism was also added. (Cassar-FRC)
W82-05386

A FEDERAL PERSPECTIVE ON RIVER BASIN MANAGEMENT,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
R. L. Pentland.
Canadian Water Resources Journal, Vol 6, No 4, p 80-94, 1981.

Descriptors: *Water management, *Federal jurisdiction, *Water policy, Planning, *Canada, Water resources development, Public participation, Data collections, Research priorities, Governmental interrelations, Local governments, Provincial jurisdiction, Jurisdiction, River basins.

The role of Canada's Federal government in water management has evolved from that of primary developer to one of joint shared responsibility with provincial or local governments. Since the passage of the Canada Water Act in 1970 and other legislation, the expensive, time-consuming comprehensive approach to planning has been changed to a more action-oriented, site-specific approach. Examples of recent evaluation processes illustrate the informal customized approach. Some studies use a formal structured procedure, and others use only those steps necessary to obtain the desired results. The philosophy of data collection is to use existing data and analytical tools maximally, because time and resources for new data and tools are not usually available. Public consultation is applied extensively at all stages of planning. Methods of obtaining and transmitting information are tailored to the type of population, type and extent of communication networks, and existing level of awareness on environmental issues. During the next decade the trend toward further federal concentration international and interprovincial systems is expected to continue. Emphasis will be placed on defining numerical values of water quality and quantity. Comprehensive planning will be undertaken only when necessary, with more attention to local issues. Other major concerns will be balancing water supply and demand, research in the field of demand management, streamflow regulation and apportionment in interjurisdictional situations, and integration of model development and data collection. (Cassar-FRC)
W82-05388

RIVER BASIN PLANNING IN ALBERTA, CURRENT STATUS--FUTURE ISSUES,
C. L. Primus.
Canadian Water Resources Journal, Vol 6, No 4, p 44-50, 1981.

Descriptors: *Planning, *Water management, Land use, River basins,*Alberta, Water resources development, Water transfer, Water allocation, Water quality, Economic development, *Legislation, Canada.

In Alberta water resources are managed on a river basin basis. The six major basins are Oldman, Bow, Red Deer, North Saskatchewan, Athabasca, and Peace. The basic objective of water resources management is to support the overall economic and social objectives of the province and to ensure that good quality water is not a limiting factor in achieving these objectives. Legislative acts dealing with water resources management are the Water Resources Act (concerns only the water resource), the Public Lands Act, and the 1977 Planning Act (land use planning and regulation). To date 7 basin and sub-basin plans have been completed and are being implemented. More comprehensive long range planning for the major basins has started with the South Saskatchewan River basin. Major issues in water management are allocation of water between basins, reallocation of existing supplies to more beneficial uses, water supply and quality as constraints to development, and establishing minimum flow requirements for stream maintenance and fisheries habitat protection. (Cassar-FRC)
W82-05390

RIVER BASINS AND WATER MANAGEMENT IN NEW BRUNSWICK,
New Brunswick Dept. of Fisheries and Environment, Fredericton.
For primary bibliographic entry see Field 6D.
W82-05391

RIVER BASIN MANAGEMENT IN ONTARIO,
J. R. Powell.
Canadian Water Resources Journal, Vol 6, No 4, p 51-65, 1981. 1 Fig.

Descriptors: *Water management, *Political constraints, *Local governments, *Ontario, Canada, River basins, Conservation Authoriities, Institutional constraints, Governmental interrelations, Financing, Water policy, Water resources development.

River basin management in Ontario is carried out by 39 Conservation Autorities, corporate bodies established by order-in-Council at the request of two thirds of the participating municipalities. This implies local management of water resources with support of the provincial and federal governments. Although significant accomplishments have been made under this system, there are many shortcomings and problems, largely political, financial, or structural. Political impediments include unclear and irrelevant policies on water management objectives, the push to eliminate Conservation Authorities and other special-purpose bodies, and the fact that authority members are not directly elected. Financial impediments include conditional grants, the proliferation of government personnel in the paperwork and administration aspects of water management, and the use of money generated by natural resources (such as forests) for popular social programs rather than for reinvestment in the resources. Structural impediments are lack of authority and jurisdiction to carry out programs, the large number of river basins not included within a Conservation Authority, and fragmentation in the extension services and in the agencies which provide money to the Conservation Authorities. The most cost-effective way of handling water resource management is a major increase in local responsibility. Some ways of accomplishing this are direct election of Conservation Authority members, deconditionalizing of grants, charging users for services, a five-fold increase in budgets, development of comprehensive river basin plans, transfer of many of the resource management functions to the Conservation Authorities, and removal of political structures. (Cassar-FRC)
W82-05393

PROMISING STEPS TOWARD A NEW OTTAWA RIVER REGULATION,
A. Harvey.
Canadian Water Resources Journal, Vol 6, No 4, p 174-186, 1981. 2 Fig, 5 Ref.

Descriptors: *Flood control, *Reservoir operation, *Water management, *River basins, Flow regulation, Ottawa River, Montreal, *Quebec, Ottawa River Regulation Planning Committee, Planning, Reservoir storage, Optimization, *Water policy, Water resources development, Canada.

The Ottowa River Regulation Planning Committee was established in 1977 to recommend flood regulation measures for the 146,334 sq km basin, located in Quebec and Ontario. The river system was well developed, with 30 large reservoirs and many smaller ones, used for hydroelectric power generation, logging, recreation, flood control, and navigation. The Committee's final report, issued in December 1980, recommended an administrative structure and use of a flexible linear optimization model for integrated operation of the existing reservoir system. This integrated operation was expected to produce a 10% flow reduction, with expectation of further flow reduction with improvements in models and forecasting and construction of new reservoirs. (Cassar-FRC)
W82-05394

NEW STRATEGIES FOR WATER RESOURCE PLANNING IN BRITISH COLUMBIA,
Department of the Environment, Victoria (British Columbia).
J. O'Riordan.
Canadian Water Resources Journal, Vol 6, No 4, p 13-43, 1981. 6 Fig, 5 Tab.

Descriptors: *Water management, *Planning, *Watershed management, *British Columbia, Canada, *Water resources development, Regional planning, Water quality management, Fisheries, Okanagan River, Nicola River, Strategic planning, *Water policy, Water resources development, River basins.

British Columbia experiences a variety of problems in water quality and managment--sedimentation from forestry, lake eutrophication, pollution from industrial discharges, lake shore developments, reservoir level fluctuations, flooding, and hydropower, development in scenic rivers. Provincial response has usually been reactive, emphasizing allocation and regulation rather than long-term management. Some more comprehensive planning and implementation programs have been undertaken with less than satisfactory results. These shortcomings have led to a new approach, strategic planning, combining comprehensive planning with increased flexibility. This approach is characterized by a regional concept (one or more watersheds), integration of water and related issues, use of existing data, and commitment to implementation. The strategic planning system is two-tiered. A policy framework is provided for a set of operational activities on a more site-specific basis. This method is illustrated using improvement in water quality for streams in the Nicola Basin, balancing the irrigation interests against the fisheries interests. (Cassar-FRC)
W82-05395

THE STATUS OF GROUNDWATER LAW IN NEW YORK STATE,
S. J. Spiegel.
Clearwaters, Vol 11, No 4, p 15-16, 1981.

Descriptors: *Groundwater, *Legal aspects, *Water quality, *New York, Regulations, Legislation, Standards, *Groundwater management, Groundwater pollution.

Groundwater law in the urban, industrially oriented eastern United States has reflected the area's relatively abundant water supply. The policy of the common law has been to encourage consumption of water rather than to protect the resource from abuse. Regulations do not effectively address all aspects of the groundwater picture. Problems which have affected groundwater fall into four categories: direct wastewater discharge to the aquifer from septic tanks, etc.; land disposal of waste in landfills, where even relatively harmless solids can result in leachate contaminating surrounding waters; contamination by non-disposal activities such as petroleum exploration, mining, storage tank spills, irrigation return flow, and infiltrating stormwater; and the relationship between depletion and pollution, including instances where withdrawal modifies natural patterns of hydrologic flow. New York regulations which contain references to groundwater protection include the Groundwater Classifications, Quality Standards and Effluent Standards, which define groundwaters and provide quality standards for potable and consumptive uses; part of the State Sanitary Code, which defines the term source of water supply; the Solid Waste Management Facilities regulations, which also defines groundwater; the Freshwater Wetlands Act, which serves to protect wetland functions, including that of a recharge area for groundwater resources; and the State Environmental Quality Review Act. In most cases the groundwater management policy is only secondarily implemented through water quality, hazardous waste and general environmental regulations. This may not provide effective protection of the

groundwater resource, especially in light of modern technological knowledge. (Baker-FRC)
W82-05400

INSTITUTIONAL CHANGE - WATER QUALITY MANAGEMENT,
R. D. Hennigan.
Clearwaters, Vol 11, No 3, p 6-7, 9-12, September, 1981. 2 Tab.

Descriptors: *Water quality, *Water management, *Legal aspects, Water resources development, Legislation, Regulations, *New York, Watershed management, Local governments, Lake watersheds.

Findings from the Central New York Water Quality Management Project have been summarized. It was learned from the study that water quality management is complicated by numerous regulations which frustrate local leadership and initiative; that under New York State constitutional law it is impossible to form local multi-county agencies; that many of the counties of Central New York operate under the county law, forcing many water quality management issues to be evaluated on a short term and out of context of other county activities; that lake watersheds usually encompass many municapilities and often cross county boundaries; and that effective water quality management programming can be effected be developing a comprehensive monitoring system. It was recommended that thee state constitution be amended so that counties can form multi-county agencies at their discretion to carry out regional missions under local control and direction; that county law should be amended to explicitly allow the counties to form water quality management agencies; that counties be allowed to develop and adopt administrative codes; and that an institutional mechanism be created to allow residents and users of lake watersheds to implement local action programs to protect water quality. (Baker-FRC)
W82-05401

GROUNDWATER STRATEGY: PROTECTING A VITAL RESOURCE,
For primary bibliographic entry see Field 5B.
W82-05403

WATER RESOURCES IN THE LEGISLATIVE BALANCE, 1982,
Library of Congress, Washington, DC.
W. Viessman, and C. Copeland.
Water/Engineering and Management, Vol 128, No 12, p 32-33, December, 1981.

Descriptors: *Water resources development, *Wastewater treatment, *Dams, *Flood plains, *Economic aspects, Legal aspects, Water supply, Economic evaluation, Water pollution control, *Water quality standards, Legislation.

Water resource topics that are likely to appear on the Congressional agenda in 1982 are identified. These include: (1) revising the provision that allows the Enviromental Protection Agency to prescribe water supply system treatment techniques, (2) increasing the scientific burden of proof that must be met before establishing national drinking water standards, (3) reviewing the adequacy of the Safe Drinking Water Act and other laws protecting groundwater resources, and (4) continuing debate on the block grant approach to funding water projects. (Titus-FRC)
W82-05433

THE RECOMMENDATIONS OF THE UNITED NATIONS WATER CONFERENCE (MAR DEL PLATA, 1977) AND RELATED MEETINGS, ON NATIONAL WATER LAWS,
International Water Resources Association, Buenos Aires (Argentina).
C. J. Cano.
Journal of Hydrology, Vol 51, No 1-4, p 381-391, May, 1981. 29 Ref.

Descriptors: *Legal aspects, *Water management, *Federal jurisdiction, State jurisdiction, Regulations, Water law, Planning, International law, Conferences.

Lawyers must work together with hydrologists, hydraulic engineers, sociologists, economists, planners, and administrators if they are to develop water laws which provide workable legal solutions to water resource management problems. This paper, prepared by a lawyer, is designed to provide non-legal professionals with information on the state-of-the-art of legal water science in the world as of 1977. Recommendations with respect to national water legislation and administration prepared by the United Nations Water Conference (U.N.W.C.), held in Mar del Plata, Argentina in 1977, and other preparatory or related international conferences are reported. Recommendations developed by the Conference addressed water policy and law, problems in preparing national water legislation, the content of water legislation, water law and water administration, and problems related to inter-jurisdictionality. The recommendations addressed such specific subject matter as water ownership; water rights; water engineering works; use of water by agriculture, fisheries, and industries; pollution; environmental impact; taxation and economic incentives; floods and other emergencies; scenic rivers; and users' participation in planning and decision-making. Recommendations made by the u.N.W.C. with respect to training and research in the field of water law are also discussed briefly. (Carroll/Frc)
W82-05492

SERVICING GROWTH IN THE METROPOLITAN TORONTO REGION DURING THE EARLY YEARS OF THE ONTARIO WATER RESOURCES COMMISSION: 1956-1968,
R. Bordessa, and J. M. Cameron.
Canadian Water Resources Journal, Vol 5, No 1, p 1-29, 1980. 1 Fig, 14 Ref.

Descriptors: *Urban development, *Land use, *Political aspects, Wastewater treatment, Ontario Water Resources Commission, Metropolitan Toronto Planning Board, Toronto, Ontario, Decision making, Sewer systems, Planning, Water policy, Water management.

The impact of the Ontario Water Resources Commission (OWRC) on growth in the metropolitan Toronto region is examined from 1956, the year of its inception, to 1968, the year of its maximum influence and beginning of curtailment in power. The origins and mandate of the OWRC and the overlapping interests and jurisdiction with the Metropolitan Toronto Planning Board (MTPB) are discussed. Three case studies illustrate the details of planning for sewage provision in the fringe areas of the city. Markham Village's request for a wastewater treatment plant to serve 4000 persons showed the decreasing effectiveness of the MTPB in maintaining the principle that servicing agreements should be contingent on planning for land use. During the several years that this request was unresolved, OWRC increased in importance and finally convinced the officials to approve funds necessary for construction. The OWRC also dominated the decision to install a package treatment plant in Markham Township rather than connect with the metropolitan Toronto sewage system as proposed by the MTPB. The eventual outcome of this case was connection with the metropolitan sewage system and a reversal of the OWRC's position on upstream plants. The last vestiges of MTPB's control over growth in fringe areas were removed by the water and sewage services plan promoted by the OWRC in South Peel. This $80 million scheme services 200 sq miles and a projected 1 million people. Growth in the outlying areas of Toronto during this period was clearly a result of servicing decisions rather than planned land use decisions. (Cassar-FRC)
W82-05566

FEDERAL WATER POLLUTION REMEDIES: NON-STATUTORY REMEDIES ARE ELIMINATED,
L. T. Vance.
Land and Water Law Review, Vol 17, No 1, p 105-137, 1982. 205 Ref.

Descriptors: *Water law, *Judicial decisions, *Legal aspects, Legislation, Water pollution, Nuisance, Regulations, Common law, Liability, Remedies, Damage, Federal Water Pollution Control Act Amendments.

Three Federal water pollution remedies--the federal common law of nuisance, the Federal Water Pollution Control Act Amendment of 1972 (FWPCAA), and private remedies implied from the provisions of the FWPCCA--are examined. In several recent decisions the U.S. Supreme Court eliminated the implied rights of action to enforce the FWPCAA and federal common law nuisance actions which seek to enjoin approved conduct. The pertinent cases were Illinois v. City of Milwaukee (which preceded the FWPCAA of 1972 by a few months), City of Milwaukee v. Illinois and Michigan (1982), and Middlesex County Sewerage Authority v. National Sea Clammers Association (1982). However, the court's decisions have effectively protected dischargers from liability for damages caused by their pollution. The federal common law of nuisance, which could play a supplemental role in achieving the goals of the FWPCAA, should be preserved to encourage citizens and states to undertake litigation against polluters. (Cassar-FRC)
W82-05603

HISTORY, PRACTICE AND EMERGING PROBLEMS OF WETLANDS REGULATION: RECONSIDERING SECTION 404 OF THE CLEAN WATER ACT,
Popham, Haik, Schnobrich, Kaufman and Doty Ltd., Denver, CO.
G. E. Parish, and J. M. Morgan.
Land and Water Law Review, Vol 17, No 1, p 43-84, 1982. 138 Footnotes.

Descriptors: *Water law, *Wetlands, *Dredging, *Permits, Regulations, Clean Water Act, Fill permits, Water quality control, Legislation, Jurisdiction, Navigable waters, Legal aspects, Fish, Wildlife, Spoil disposal, Land use.

Section 404 of the Clean Water Act required potential dischargers to secure permits from the Corps of Engineers before dredge or fill materials are dumped into navigable waters. Securing a permit is very difficult, entailing complex application procedures and involvement with several federal agencies. This paper examines the Section's deviations from the Congressional purpose and constitutional foundations of water law, the process problems involved in securing a permit, and suggestions for facilitating the process. Jurisdictional problems arise in the definition of whether a wetland is water and which waters are considered navigable. Permits are not needed for dredged and fill material from several specified activities such as agriculture, structure maintenance, and construction of irrigation or drainage ditches and ponds. General permits, allowing some activities to take place without going through the application process, were intended to simplify the process but have produced the opposite result. Standards for permit review have been broken down into 12 general policies, the most important of which are public wildlife. Permit processing procedures are described for routine cases and cases in which controversy is expected. Suggestions for reform are discussed under the categories: legislative (jurisdictional, permit standards, permit procedures reform) and alternatives to wetland protection (regulatory and nonregulatory). (Cassar-FRC)
W82-05604

CONFLICT BETWEEN ESTABLISHMENT OF INSTREAM FLOWS AND OTHER WATER USES ON WESTERN STREAMS,
Colorado State Univ., Fort Collins.
R. L. Anderson.
Water Resources Bulletin, Vol 18, No 1, p 61-65, February, 1982. 7 Ref.

Descriptors: *Instream flow, *Legal aspects, *Water rights, *Water use, Water management, *Competing use, Water allocation, Water supply, *Western United States.

Concentrated efforts have been made in the past two decades to establish and legitimize public use of water for recreation, scenic, esthetic, water quality, fisheries, and similar instream uses. However, application of minimum instream flow policies and programs to western rivers can result in conflicts with other long established users as a result of climatic conditions. The economic and social structure of many western areas is dependent on utilization of limited and highly stochastic water supplies. In some cases, the specified flow required to meet the instream flow uses exceeds the average natural flow of the particular river. In many other cases, the specified instream flow requirement would necessitate diverting flow from uses already in place or from anticipated and already-planned uses. Many of the current users have made significant financial investments in systems which depend on access to given water supplies. In addition, water rights in western states constitute property rights subject to due process and compensation. Therefore, attempts to deprive these users of their current water supplies could be expected to result in intense legal proceedings with respect to constitutional rights and property rights. It is concluded that establishment of minimum instream flows on western streams will be difficult and costly in many cases, create conflict in almost all instances, and disrupt established water uses or threaten to disrupt water development plans of many users. (Carroll-FRC)
W82-05749

THE OKANAGAN BASIN AGREEMENTS--AN EXAMPLE OF INTEGRATED WATER RESOURCE PLANNING IN BRITISH COLUMBIA,
A. M. Thomson.
Canadian Water Resources Journal, Vol 5, No 3, p 6-14, 1980. 2 Fig.

Descriptors: *Water management, *Water policy, Okanagan River, *British Columbia, Canada, Planning, Water quality, Water supply, Recreation, Fisheries, Environmental effects, Social impact, Flood plain management, Flow regulation, Public opinion.

The Okanagan Basin Study and subsequent Implementation Agreement illustrate integrated water resources planning in British Columbia. Two major problems exist in this arid, warm region, 3165 sq miles in area: extremely variable annual runoff (80,000 to 800,000 acre feet) and deterimorating water quality caused by population growth. The Basin Study, undertaken jointly by the provincial and federal governments in 1969-73, developed a framework plan for water management to the year 2020. Goals were not limited to economic growth as in the past, but also included environmental quality and social betterment. In February 1976 the provincial and state governments entered into an Implementation Agreement. The main activities involve development actions to achieve plan objectives, monitoring of the effectiveness of these actions, and a comprehensive review in 1980 and 1981. Major components of development action are water quantity, water quality, fisheries, and recreation. Public response will be reflected during the implementation phase. (Cassar-FRC)
W82-05779

THE SAFE DRINKING WATER ACT ON REVIEW,
Johnson (C. C.) and Associates, Inc., Silver Spring, MD.
For primary bibliographic entry see Field 5G.
W82-05792

LAW FOR ENVIRONMENTALISTS,
For primary bibliographic entry see Field 5G.
W82-05813

THE NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS, PART I - HISTORICAL DEVELOPMENT,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
For primary bibliographic entry see Field 5G.
W82-05814

THE NATIONAL INTERIM PRIMARY DRINKING WATER STANDARDS. PART II. IMPACT ON COMMUNITY WATER SYSTEMS. THE INDIANA EXPERIENCE,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
For primary bibliographic entry see Field 5G.
W82-05815

AMERICAN INDIAN WATER RIGHTS AND THE USE OF COLORADO RIVER WATER,
S. K. Smith.
Water Supply and Management, Vol 6, No 1-2, p 75-86, 1982. 1 Fig, 4 Tab.

Descriptors: *Riparian rights, *Water law, *Colorado River, *River basin development, *Water demand, Water rights, River basins, Water resources development, Water policy, Legal aspects, Resources development, Water supply development, Natural resources.

Indian Water rights are considered paramount over nonIndian water rights because nearly all Indian reservations were created prior to the diversion of waters from the rivers of the Western United States by nonIndian interests. This theory was reinforced by the Supreme Court decision in the case of Winters vs. U. S., in which it was stated that Indians has command of the lands and the waters on Indian reservations. The quantification of these water rights is still being litigated for Indian reservations in the Colorado River Bbasin. The waters of the Colorado River are important to the Indians not only for domestic and agricultural needs, but for sacred purposes and fishing as well. Significant energy resources are located on Indian lands, but many impediments exist to their development. More compromise between factions of varying interests will be needed in the future for the development of competing water demands and the definition of Indian water rights. (Geiger-FRC)
W82-05885

6F. Nonstructural Alternatives

FLOODS OF SEPTEMBER 16, 1975 IN TALLABOA VALLEY, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
K. G. Johnson.
Geological Water Resources Investigations, Open-File Report 80-1283, April 1981. 5 Sheets, 10 Fig, 1 Tab, 4 Ref.

Descriptors: *Floods, *Floods frequency, *Flood peak, *Flood plain management, Flood discharge, Flood recurrence interval, Flood profiles, Flood data, *Puerto Rico, *Tallaboa Valley.

The most severe flood since 1928 inundated the Rio Tallaboa Valley on the south coast of Puerto Rico on September 16, 1975. Peak discharge was about 666 cubic meters per second. The flood has an estimated recurrence interval of 20 years. The data provided in the report can be used in making rational decisions in formulating effective floodplain regulations that would minimize flood problems in the Tallaboa Valley. (USGS)
W82-05230

CAN THE GOALS OF THE UN DECADE ON WATER SUPPLY AND SANITATION BE ACHIEVED,
Amsterdam Water Works (Netherlands).
For primary bibliographic entry see Field 6B.
W82-05365

RIVER BASIN PLANNING IN ALBERTA, CURRENT STATUS--FUTURE ISSUES,
For primary bibliographic entry see Field 6E.
W82-05390

THE UNCERTAIN QUEST FOR A MANAGEMENT STRATEGY IN THE FRASER ESTUARY,
British Columbia Univ., Vancouver. Westwater Research Center.
A. H. J. Dorcey.
Canadian Water Resources Journal, Vol 6, No 4, p 95-118, 1981. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Water management, *Planning, *Decision making, Water quality management, *Fraser River, *Estuaries, River basins, Management, Data collections, Political constraints, Institutional constraints, Water policy, Water resources development, *British Columbia, Canada.

The growing pressure of conflicting interests in the Fraser River estuary led to intensive planning activities during the 1970's. The expansion of the Vancouver Airport was a catalyst in development of an estuary management plan. The Fraser River estuary study was initiated in 1977 to focus on all uses of estuarine resources. In Phase I reports were prepared on land use, transportation and port development, water quality, recreation, and habitats. This pointed out the need for a comprehensive management plan, designated as Phase II and scheduled for completion in 1982. Progress has been made in generating information necessary for decision making, especially from the required environmental impact assessments. Description knowledge is presently fair to very good in most fields, but functional knowledge (causes and effects) is still only poor to fair, except in hydrology. This lack of knowledge is a major constraint on decision making. Negotiations have been successful within the government but not among non-governmental interests. Phase I suggested new institutional arrangements for linking decision making with organizational arangements for planning. Three interagency groups were suggested: a constituency (all interested parties), a policy group (key agencies), and an estuary council (small group responsible for formalizing policies). (Cassar-FRC)
W82-05392

RIVER BASIN MANAGEMENT IN ONTARIO,
For primary bibliographic entry see Field 6E.
W82-05393

FLOODPLAIN ANALYSIS, SIMPLIFIED VS. COMPLEX METHODS: A CASE STUDY,
Enviroscience, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 4A.
W82-05732

STRATEGIES FOR REUSE AND CONSERVATION,
Dames and Moore, Houston, TX.
For primary bibliographic entry see Field 3C.
W82-05790

6G. Ecologic Impact Of Water Development

AN ECOLOGICAL STUDY OF AN ANTARCTIC FRESHWATER POOL WITH PARTICULAR REFERENCE TO TARDIGRADA AND ROTIFERA,
Department of Science, Melbourne (Australia).
For primary bibliographic entry see Field 2H.
W82-04950

RARE AND ENDANGERED SPECIES: FRESHWATER GASTROPODS OF SOUTHERN NEW ENGLAND,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 5C.
W82-04968

ILLINOIS WETLANDS: THEIR VALUE AND MANAGEMENT,
Rock Valley Metropolitan Council, Rockford, IL.
H. E. Bell, III.
Illinois Institute of Natural Resources, Chicago, Document No 81/33, October 1981. 133 p 5 Fig, 12 Tab, 121 Ref.

Descriptors: *Wetlands, *Wildlife habitats, *Wildlife conservation, *Resources management, Ecol-

ogy, *Drainage, Sediments, Water pollution control, Permits, Economic justification, Swamps, Marshes, Soil types, Soil saturation, Preservation, *Illinois.

In the last 100 years, approximately 99.5 percent of Illinois wetlands has been destroyed because they were considered useless and the land could be put to better use with higher economic yield. This report details the diverse value of wetlands and outlines the means of preserving, restoring, and managing them. Wetlands are valuable for many reasons: they provide a habitat for threatened and endangered species; they filter pollutants from rivers and lakes without the high cost of treatment plants, i.e., excessive nutrients are chemically locked into wetland soil or absorbed by plants; and they can act like sponges during floods by storing water in floodplain forests, in depressions like shrub swamps and marshes, or in sandy soils. There are also potential benefits in treating wastewater with artificial wetlands. Most Illinois wetlands are theatened with destruction; federal, state, and local laws---404 permits, Section 10 permits, the Endangered Species Act---do not provide adequate protection. Local citizens need to take a more active role in wetlands protection and management by voicing their concerns to the agencies responsible for administering the regulations, such as regional planning commissions and councils of governments. Wetlands can be protected by public acquisition, such as by the U.S. Fish and Wildlife Service and the Illinois Department of Conservation. Landowners must also protect their wetlands from adjacent land use that can disturb their hydrology or vegetation. Wetlands are not wastelands and should be managed for all the benefits they offer. Preservation is the best type of management. (Atkins-Omniplan)
W82-05053

THE ECOLOGY OF BOTTOMLAND HARDWOOD SWAMPS OF THE SOUTHEAST: A COMMUNITY PROFILE,
Georgia Univ., Athens. Inst. of Ecology.
C. H. Wharton, W. M. Kitchens, E. C. Pendleton, and T. W. Sipe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199837, Price codes: A07 in paper copy, A01 in microfiche. Biological Services Program FWS/OBS-81/37, March, 1982. 145 p, 53 Fig, 17 Tab, 281 Ref, 1 Append.

Descriptors: *Bottomland, *Swamps, *Ecology, *Hydrology, *Flood plains, Wetlands, Runoff, River systems, Fauna, Plant populations, Geochemistry, Water level fluctuations, Erosion, Soil water, Flooding, Hardwood swamps, Southeast United States.

Bottomland hardwood forests and their fauna comprise remarkably productive riverine communities adapted to a fluctuating water level ecosystem characterized and maintained by a natural hydrologic regime of alternating annual wet and dry periods. This community profile has been prepared in part to provide information for management decisions. The entire bottomland over which flooding occurs is a functional part of the wetland system and must be considered as a unit when making resource decisions. Water is the driving force of the bottomland hardwood community. Sources of water to bottomlands include precipitation and runoff from mountains and Piedmont, groundwater from rainfall, underground aquifers, continuous seepage from sand aquifers, and tidal flow. The physicochemical environment of the floodplains is a function of the interactions or processes occurring in the water column, in soil, and at the soil-water interface. The plant species and communities that inhabit the floodplain can be considered as buffers that absorb and dissipate the physical energies of the riverine system. Water movement is slowed and erosion is held in check through the anchoring of sediments by root systems, the deposition of sediments that are dropped from the slowed water column, and the reduction of the water column by the spreading out of water. The buffering role of the plant communities is also evident in the biogeochemical cycles of the riverine-palustrine system. The moisture gradient and hydroperiods of floodplains provide a continuum for a diverse fauna. Bottomland swamps are integrally coupled to the surrounding uplands, downstream estuarine systems, and the atmosphere. (Moore-SRC)
W82-05054

MAN-MADE STORAGE OF WATER RESOURCES--A LIABILITY TO THE OCEAN ENVIRONMENT. PART II,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 4A.
W82-05126

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 2 - ENVIRONMENTAL CONTROL TECHNOLOGY,
California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5E.
W82-05213

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 1 - ENVIRONMENT, HEALTH AND SOCIO-ECONOMICS,
California Univ., Livermore. Lawrence Livermore Lab.
L. Anspaugh, N. Crow, D. Ermak, C. Hall, and J. Kercher.
Department of Energy Report DOE/EV-0092, July 1980. 246 p, 53 Fig, 25 Tab, 203 Ref, 1 Append. Layton, D., ed. W-7405-ENG-48.

Descriptors: *Geothermal resources, *Environmental effects, *Social impact, *Economic impact, *Geothermal power, Resources development, Public health, Subsidences, Cooling water, Injection, Irrigation, Wastewater disposal, Irrigation-return flow, Salinity, Salton Sea, *Imperial Valley, California.

The Imperial Valley contains nearly a third of the nation's identified hot-water geothermal resources. The valley, with its 475,000 acres of irrigated lands and warm climate, also represents one of the more important agricultural resources of the United States. The most important potential impacts involve air quality changes resulting from emissions of hydrogen sulfide, and increases in the salinity of the Salton Sea resulting from the use of agricultural waste waters for power plant cooling. Extensive withdrawals of agricultural waste waters to support geothermal development will accelerate increases in the Salton Sea's salinity, putting added stress on its quasi-marine ecosystem. Large withdrawals of waste waters would not be necessary if steam condensate was used as the sole source of cooling water for flashed-steam power plants. A county policy favors the full injection of withdrawn geothermal fluids in order to protect against land subsidence, and therefore external sources of water will probably be needed for geothermal operations. For the most part, geothermal activities will be compatible with irrigated agriculture, but negative impacts of a site-specific nature caused by land subsidence, cooling tower drift, or accidental spills of geothermal fluids could occur. Residual geothermal fluids will be disposed of by subsurface injection to geothermal reservoirs. The socioeconomic consequences of geothermal development will generally be beneficial. (Moore-SRC)
W82-05214

DEVELOPMENT OF NATURAL SUBIRRIGATION OF LANDS AND ITS PREDICTION NEAR LARGE RESERVOIRS,
Northern Scientific Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR).
For primary bibliographic entry see Field 4A.
W82-05238

THE ECOLOGICAL CASE FOR THE CREATION OF THE DANUBE-DNIEPER WATER RESOURCES UTILIZATION SYSTEM,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. D. Romanenko, O. P. Oksiyuk, V. N. Zhukinskiy, and Y. R. Shelyag-Sosonko.
Hydrobiological Journal, Vol 16, No 1-10, 1980. 3 Ref.

Descriptors: *Ecological effects, *Water resources development, *Aquatic life, *Danube River, *USSR, Reservoirs, Diversion structures, *Dnieper River, Black Sea, Rivers, Salinity, Waterlogging, Canals, Water conveyance, Algae, Phytoplankton, Fish management, Water quality, Self-purification, Geochemistry, Groundwater levels, Vegetation, Hydraulic structures.

The ecological results of the proposed Danube-Dnieper water diversion project must be considered in the planning stage. The project involves water bodies of different types: rivers, estuarine regions, salt water lagoons, canals, and conduits. Many changes in water quality and biological life will be produced by water resources development in this region. Closing the estaries will freshen water there, replacing marine ecosystems with fresh water ecosystems. Limitation of discharge into the Black Sea will change the salinity and the nature of the aquatic life there. Construction of the Ochakov barrage will transform the Dnieper-Bug salt lagoon into a fresh water body and act as an obstacle to diadromous fish spawning. However, reproduction of bream, pike, and perch will be improved. The nature of the artifical water courses (canals and closed conduits) and pumping stations can profoundly affect water quality and phytoplankton populations. Possible effects on the land include changes in groundwater levels, salinization, and vegetation changes. (Cassar-FRC)
W82-05329

FISHERY IMPORTANCE OF THE URAL-CASPIAN FISHING DISTRICT AND PROBLEMS OF ITS WATER SUPPLY,
For primary bibliographic entry see Field 8I.
W82-05342

THE SHUBENACADIE-STEWIACKE RIVER BASIN STUDY,
Department of the Environment, Halifax (Nova Scotia).
For primary bibliographic entry see Field 6B.
W82-05385

CALIFORNIA'S PERIPHERAL CANAL: SKIRTING THE DELTA - AND THE ISSUES,
For primary bibliographic entry see Field 4A.
W82-05411

ENVIRONMENTAL ASPECTS OF MULTIPURPOSE RESERVOIR PROJECTS IN DEVELOPING COUNTRIES,
H. F. Ludwig.
Water Science and Technology, Vol 14, No 1/2, p 269-280, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Environmental impact statement, *Developing countries, *Water resources development, *Thailand, *Multipurpose reservoirs, Planning, Reservoirs, Dam effects, Mekong River, Fisheries, Forestry, Wildlife, Economic impact, Social impact, Monitoring.

In Thailand water development projects have been planned to meet specific needs (power generation, irrigation, and flood control), with little attention paid to environmental impacts. This traditional attitude needs to be modified to consider effects of reservoirs on water quality and ecology to make them truly multipurpose. Fisheries, forestry, wildlife, agro- and other local industries, families in the zone of inundation, and villages outside the flooded region are all environmental issues which should be included in total planning. Continued monitoring of project impacts after construction, rarely done at present, can be valuable in planning future projects. Supplemental tables and graphs give suggested budget allowances for environmental impact assessment studies in Thailand and environmental impact guidelines for dams and reser-

voirs. For additional help 25 references on environmental impact statement methodologies which are applicable to dam and reservoir projects and six environmental impact statement reports on Thailand projects are given in the appendix. (Cassar-FRC)
W82-05426

THE LONG LAKE DIVERSION: AN ENVIRONMENTAL EVALUATION,
Ontario Ministry of Natural Resources, Thunder Bay.
S. E. Peet, and J. C. Day.
Canadian Water Resources Journal, Vol 5, No 3, p 34-48, 1980. 3 Fig, 15 Ref.

Descriptors: *Environmental effects, *Diversion structures, *Water transfer, Long Lake, Ontario, Lake Superior, Aguasabon River, Kenogami River, Albany River, Interbasin transfers, Social impact, Economic impact, Logging, Pulp and paper industry, Reservoirs, Canals, Rivers, Water management, Water quality, Water pollution effects, Recreation, Aesthetics, Erosion, Shores, Aquatic life, Fish, Hydroelectric stations, Dams.

The environmental effects of the Long Lake Diversion, northern Ontario, were evaluated. The first phase, consisting of two dams and a 5-1/4 mile diversion canal, redirected the northward flowing Kenogami River south to Lake Superior. The second phase, completed in 1948, added a dam and hydroelectric station. At that time power generation and interbasin pulpwood transportation began. Effects of the four types of hydrologic modifications were: (1) downstream--highly variable flow conditions, habitat losses, decreased biological production, esthetic impairment, little socioeconomic effect, (2) Long Lake receiving water body--alteration of 10 miles of the Kenogami River with resultant navigational and esthetic impairment, severe shoreline erosion, flooding, accumulation of logging debris, interference with a municipal water supply inlet, damage to an Indian cemetary, (3) diversion channel--disturbance of fish habitats and interbasin movement, temporary construction effects, increase in aquatic macroinvertebrates, damage to fish spawning beds, impairment of water quality and esthetic values, and (4) reservoir--minimal effects due to good planning. Forty years of log handling has negatively affected water quality, aquatic communities, and recreational users. However, economic analysis and a public opinion questionnaire indicated that the overall social and economic benefits have exceeded the negative effects. (Cassar-FRC)
W82-05568

STREAM IMPROVEMENT: THE CHICOD CREEK EPISODE,
Soil Conservation Service, Greenville, NC.
For primary bibliographic entry see Field 4D.
W82-05717

NORTHWESTERN ONTARIO RIVER DIMENSIONS,
Simon Fraser Univ., Burnaby (British Columbia).
J. C. Day, K. C. Bridger, S. E. Peet, and B. F. Friesen.
Water Resources Bulletin, Vol 18, No 2, p 297-305, April, 1982. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Diversion structures, *Environmental effects, *Reservoirs, *Canada, Long Lake Diversion, Ogoki Diversion, Ontario, Great Lakes, Social impact, Economic impact, Aquatic habitats, Recreation, Fish, Logging, Erosion, Silting, Hydroelectric power, Water transfer, Interbasin transfer, Turbidity, Benefits, River basins.

Biophysical and socioeconomic effects of the Ogoki Diversion and the Long Lake Diversion, two small basin water diversion projects in Ontario, are described. Both projects have produced valuable benefits--hydroelectric power, log transport, access roads, and economic development. Problems have been caused by failure to clear trees before inundation, water level fluctuations, erosion, siltation, reduced or increased river flows, and debris from log transport. As a result of the perturbations, aquatic communities have been eliminated or changed; recreation and commercial fishing have been adversely affected in some sections; 11 acres of property on an Indian Reserve partly occupied and partly of archeological interest, have been lost through erosion; wild river reaches have been drowned; water quality has been impaired by pulpwood leachates; and the shoreline appearance has been impaired. It is suggested that early public participation is desireable in planning projects of this type and scale. The esthetic and other environmental disturbances should be avoided. River regulation in the north should be confined to certain watersheds, while allowing other basins to remain unchanged. (Cassar-FRC)
W82-05742

WATER QUALITY MANAGEMENT IN BRITISH COLUMBIA,
Pollution Control Board (British Columbia).
For primary bibliographic entry see Field 5C.
W82-05767

A CITIZEN'S VIEW OF WATER MANAGEMENT IN THE OKANAGAN VALLEY,
J. Woodworth.
Canadian Water Resources Journal, Vol 5, No 3, p 15-25, 1980. 1 Fig.

Descriptors: *Water management, *Water policy, *Clearcutting, History, Okanagan River, British Columbia, Planning, Population dynamics, Water supply, Forest management, Public opinion, Irrigation, Recreation, Fish.

The desert-like Okanagan Valley, British Columbia, did not support a sizeable population until irrigation began in the early 1900's. Subsequent water resources development after World War I stimulated population growth so that at present the area is a suburb of neighboring Vancouver, Calgary, and Edmonton. Land use conflicts have developed among residents desiring to water lawns and gardens, farmers, loggers, cattlemen, skiers, and fisherman. In particular, clearcutting and insufficient reforestation in the uplands watershed is widespread but out of view of most of the residents in the valley. Although a Basin Study and Implementation Agreement has provided for water management, the Citizens Task Force review of 1980 agreed on 2 priorities: central, rather than fragmented, water management and serious examination of the effects of clearcutting in the mountains. (Cassar-FRC)
W82-05781

IMPACT OF ENERGY DEVELOPMENT UPON WATER AND SALINITY IN THE UPPER COLORADO RIVER BASIN,
For primary bibliographic entry see Field 3C.
W82-05886

THE COLORADO RIVER SALINITY PROBLEM,
Environmental Protection Agency, Ada, OK. Robert S. Kerr Environmental Research Lab.
For primary bibliographic entry see Field 5G.
W82-05889

7. RESOURCES DATA

7A. Network Design

HYDROLOGIC MONITORING IN THE COAL FIELDS OF CENTRAL UTAH, AUGUST 1978-SEPTEMBER 1979,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines, and G. G. Plantz.
Geological Survey Open-File Report 81-138 (WRI), 1981, 56 p, 30 Fig, 1 Plate, 13 Tab, 17 Ref.

Descriptors: Surface water, *Monitoring, *Water quality, *Networks, Data collections, *Coal mines, Hydrologic cycle, Streamflow, Flow characteristics, Flow measurement, Sediments, Mine drainage, Groundwater storage, Groundwater movement, Chemical analysis, *Utah, Wasatch Plateau coal field, Book Cliffs coal field, Emery coal field.

Surface-water quantity and quality were monitored at 12 gaging stations down-stream from mine and lease areas in the Wasatch Plateau, Book Cliffs, and Emery coal fields in central Utah. Measurements of base flow were made at 52 other sites in the region. The report describes the hydrologic setting of this important coal region and summarizes the surface-water data collected at the monitoring sites from August 1978 through September 1979. Coal mining and lease activities in each of the monitored basins also are described. Where possible, hydrologic impacts of coal mining are evaluated. Impacts include increases in streamflow and degradation of surface-water quality due to water discharged from underground mines. Other impacts include removal of water from groundwater storage, changes in the natural ground-water flow system and possibly the diminution of spring flows. Adequacy of the monitoring network to detect hydrologic changes due to mining is evaluated. In order to fully assess and quantify the impacts, comprehensive studies and monitoring of the ground-water system and water produced in mines are needed. (USGS)
W82-04976

A RIVER CODING SYSTEM FOR WATER QUALITY ARCHIVES,
Fourth River Purification Board, Edinburgh (Scotland).
R. J. Sargent.
Water Pollution Control, Vol 80, No 5, p 682-686, 1981. 3 Fig, 1 Tab.

Descriptors: *Computers, *Coding systems, *River systems, Sites, Sampling, Gaging stations, Data collection, Data processing, Hydrologic data, Network design, Catchment basins, Great Britain.

The Forth River Purification Board in Edinburgh, Great Britain, has adopted a river coding system to describe the location of such features as sampling points, discharges, and gauging stations. The coding system was designed to facilitate the retrieval of information stored in various files on the computer, with respect to both available data relative to a given point and data relating to the position of a given geographical location within the river network. The constraints on the coding system were that the code should uniquely define a point on any and every watercourse, that the code should be as compact as possible, that the system should be sufficiently flexible to enable new watercourses to be added and varying densities of points to be identified, and that the system should have built into it the logic of the watercourse to enable accessing of upstream and downstream information from any given reference point. Each code has three parts: a number identifying the river catchment; a river number; and a distance number which gives the distance in river kilometers of the location from a defined starting point. Treatment of specific aspects of the hydrologic system and implementation on the coding system are described. (Carroll-FRC)
W82-05474

MEASURING RESERVOIR GROUND MOVEMENTS,
Nottingham Univ. (England).
For primary bibliographic entry see Field 8G.
W82-05773

THE MACKENZIE RIVER BASIN STUDY,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
For primary bibliographic entry see Field 4A.
W82-05778

7B. Data Acquisition

NEW DEVELOPMENTS IN AUTOMATED BIOSENSING FROM REMOTE WATER QUALITY STATIONS AND SATELLITE DATA RETRIEVAL FOR RESOURCES MANAGEMENT,

Tennessee Technological Univ., Cookeville.
E. L. Morgan, K. W. Eagleson, R. Hermann, and N. D. McCollough.
Journal of Hydrology, Vol 51, No 104, p 339-345, May, 1981. 2 Fig, 6 Ref.

Descriptors: *Sensors, *Remote sensing, *Bioindicators, *Water quality management, *Satellite technology, Fish, Fish behavior, Pollution load.

Increasing demands on water resources have intensified the need to maintain the environmental integrity of multipurpose drainage systems. As a result, there is increased interest in new, real-time methods for evaluating biological and physical-chemical water quality. A real-time automated biosensing unit has been designed which uses fish breathing rates as a measure of biological response or integration to water quality changes. Previous studies have shown that fish alter their typical breathing patterns in response to stressful conditions and that this function is a good physiological measure of chronic levels of a broad spectrum of toxic substances and environmental stresses. Biosensing units utilizing microprocessor-based monitors to measure fish breathing are interfaced to a remote data collection platform for satellite retrieval and transmission of data. The biosensor is used in conjunction with complex remote in-stream systems which collect information on a variety of physical parameters. These monitors, whiich are linked by radiotelemetry to central processing centers, may operate from such devices as buoys, mobile trailers, or stream-side stations. Real-time biological and physical data are transmitted to the data processing center, where they are readily available for interpretation by resource managers. (Carroll-FRC)
W82-04800

TOWARDS DIGITAL TECHNOLOGY IN THE MEASUREMENT AND CONTROL OF WATER LEVELS,
Churchill Controls Ltd., Reading (England).
J. W. Churchill.
Water Services, Vol 85, No 1030, p 599-600, 605, December, 1981. 5 Fig.

Descriptors: *Telemetry, *Remote sensing, *Water levels, Electronic equipment, Capacitance, Sensors, Transducers, Water depth, Automation, Computers, *Reservoirs.

The adoption of large digital telemetry systems by the service industries, including the water industry, is influencing the choice and development of the basic sensors and the forms of signalling they employ. The principle of capacitance for measuring liquid depth via immersion of a rod or wire is not new, but successful application of this principle was difficult. In a new device a concentric construction was adopted with a grounded tube surrounding a sensitive capacitance electrode, combined with a new form of electronic sensor. The water rises inside the tube to the same level as its surroundings and changes the capacitance of the wire in a manner strictly proportional to the water depth. The change in capacitance is substantial -- on the order of 2500 pf per meter. The polarity reversal time of the capacitor forms a type of audio frequency oscillator, whose signals can be transmitted over an ordinary telephone line or radio link. The transducer calibration is not voltage dependent; batteries or line voltage may be employed. The receiving circuit in its simplest form comprises an analog converter, which may give a reading on a meter or actuate high and low level signals. For digital use, microprocessor chips receive the signal as a pulse count which is timed against the processor's crystal clock. Thus a direct measure of water depth is obtained which is entirely independent of analog voltage references and is suitable for intermittent interrogation. (Carroll-FRC)
W82-04847

MOISTURE ANALYSIS FROM RADIOSONDE AND MICROWAVE SPECTROMETER DATA,
Florida State Univ., Tallahassee. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W82-04900

HYDROLOGY OF THE WINTER HAVEN CHAIN OF LAKES, POLK COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04977

CONTINUOUS MEASUREMENTS OF DISSOLVED OXYGEN IN WATER CULTURE BY A SELF-CALIBRATING MONITOR,
Ben-Gurion Univ. of the Negev, Beersheba (Isreal). Dept. of Electrical Engineering.
S. Ben-Yaakov, and Y. Ben-Asher.
Water Research, Vol 16, No 2, p 169-172, February, 1982. 5 Fig, 7 Ref.

Descriptors: *Dissolved oxygen, *Measuring instruments, Monitoring, Eutrophication, Water quality, Calibrations, Technology, *Analytical techniques.

A study was conducted to develop a self calibrating oxygen monitor for continuous measurements in water culture. The self-calibrating oxygen system (SCOS) developed is described. The probe is suitable for installation and in situ monitoring of oxygen concentration in hydroponics installations and other water bodies. The sensor comprises a gold cathode, a silver anode and a teflon membrane separating the internal electrolyte from the test solution. The current output of the sensor is fed to a temperature compensating current-to-voltage converter which is built around a commercial operational amplifier with a thermistor in the feedback loop. The thermistor was chosen to provide temperature independent reading of the partial pressure of oxygen. The sensor was mounted in a flow-through cell through which the solution was circulated by a submerged centrifugal pump. The flow-through cell design was such that it will empty when the circulation pump is stopped. This feature is applied during the autocalibration phase, in which air is used as a partial pressure oxygen standard. Specially designed self-adjusting electronic circuitry is activated during the autocalibration stage to adjust the overall gain of the instrument so that the output reading will reach the desired leve. The gain is then left constant until the next autocalibration cycle. The temperature dependence of the uncompensated sensor response followed the theoretical relationship. The present configuration of the flow cell permitted rapid and simple maintenance of the dissolved oxygen sensor. The maintenance routine requires cleaning of the sensor's head by fresh water once a month and replacement of membrane and internal solution every 3 months. When monitoring highly eutrophic solutions a more intensive maintenance schedule is needed. (Baker-FRC)
W82-05015

DEVICE FOR CONTINUOUS MEASUREMENT OF PRIMARY PRODUCTION OF WATER BODIES AND BIOCHEMICAL OXYGEN DEMAND,
Moscow State Univ. (USSR).
G. G. Shinkar, V. V. Sapozhnikov, and A. A. Georgiev.
Water Resources, Vol 8, No 2, p 205-209, March-April, 1981. 3 Fig, 1 Ref. Translated from Vodnye Resursy, No 2, p 156-160, March-April, 1981.

Descriptors: *Primary productivity, *Dissolved oxygen, Productivity, Algae, Oxygen, *Biochemical oxygen demand, Lakes, Measuring instruments, Technology.

A productiometer was developed to measure primary productivity from the difference of oxygen concentrations in light and dark bottles. The bottles are installed in the water body at 0.5 m depth. Water is pumped through both bottles at the same rate. Dissolved oxygen is measured in both light and dark bottles, and the difference is used to calculate the gross productivity of the phytoplankton. These measurements are read by remote detectors and recorded automatically on shore. Glass cylinders are more satisfactory than rectangular glass boxes. This continuous method gives higher results than the traditional optimal conditions for light and nutrient supply. (Cassar-FRC)
W82-05028

PROCEDURES FOR THE COLLECTION OF REPRESENTATIVE WATER QUALITY DATA FROM MONITORING WELLS,
Illinois State Water Survey Div., Campaign; and Illinois State Geological Survey Div., Champaign.
J. P. Gibb, R. M. Schuller, and R. A. Griffin.
Cooperative Groundwater Report 7, 1981. 22 Fig, 10 Tab, 27 Ref.

Descriptors: *Water sampling, *Water analysis, Monitoring, Well data, *Water quality, Sample preservation, Chemical properties, On-site tests, Water quality standards, Drawdown, Operating policies, Pumping tests, Submersible pumps, Well filters, *Waste dumps, *Leachates, *Illinois.

Regulatory agencies are charged with setting design and operational standards for waste disposal facilities to insure that the environment is not adversely affected. Well sampling is the usual method of monitoring the effects on goundwater. The purposes of this study were to determine: (1) if current sampling methods yield representative samples of the aquifer being monitored; (2) if field samples must be treated (filtered and acidified) on-site of if they can be taken to a lab for treatment and suffer no chemical alteration; and (3) which sampling and preservation methods should be accepted as standards for monitoring well sampling. Four types of pumping methods were used to collect samples from monitoring wells at six Illinois sites. The selection of the type of sampling device; sample preparation, preservation, and storage; and sampling procedures all must be tailored to the size and accessibility of the individual well, its hydrologic and chemical character, the chemical constituents of interest, the time of year, and the purpose for monitoring. Generally recommended sampling procedures include: (1) using peristalsis or submersible diaphragm type pumps; (2) conducting pump tests prior to sampling to determine sampling frequency and time and rate of pumping; (3) flushing the well by pumping 4-to-6 well volumes; (4) measuring pH, specific conductance, oxidation-reduction potential, and alkalinity at the time of sample collection; and (5) filtering samples immediately on-site through a 0.45 millimicron pore size filter and then preserving the samples immediately after filtration, according to U.S. EPA recommended procedures. (Atkins-Omniplan)
W82-05051

A LOW-COST MULTICHANNEL RECORDING PIEZOMETER SYSTEM FOR WETLAND RESEARCH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond.
Water Resources Research, Vol 18, No 1, p 182-186, February, 1982. 5 Fig, 6 Ref.

Descriptors: *Piezometry, *Wetlands, *Automation, Marshes, Water table fluctuations, Measuring instruments, Tidal marshes, Sonar, Piezometers, Costs.

An acoustic system for continuous recording of piezometric head in wetlands is composed of a sonar transmitter-receiver, consisting of a pulse generator, receiver, timer, display, and switching unit; a digital data logger; transducers and their cables, built from ordinary earphones; a power supply (12-volt lead-acid motorcycle battery); and piezometers for saltwater use. Costs vary from $500 for manual operation to $1000 for automatic operation, not including the cost of the data logger and data cassette ($1000 each). This system has a rapid response, avoids disturbances in piezometric head caused by human weight on the compressible peat surfaces, and permits automatic readings at short time intervals, during storms, and for long periods. (Cassar-FRC)
W82-05076

ON THE DETERMINATION OF THE DEGREE OF WEEDAGE IN FLOWING WATERS (ZUR

ANSPRACHE DES 'VERKRAUTUNGSZUSTANDES' IN FLIESS-GEWASSERN),
E. Niemann.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 47-57, 1980. 8 Fig, 2 Tab, 3 Ref. (No English summary).

Descriptors: *Data acquistion, *Aquatic plants, *Shoreline cover, Streams, Streamflow, Hydraulic properties, *Running waters, Bioindicators, Biological communities, *Numerical analysis, Seasonal distribution.

Weedage is defined as the development of the entire submerse and emerse phytobenthos within the summer median water level of flowing waters. The description of the weedage in order to draw conclusions regarding water treatment or evaluation necessitates consideration of both quantitative development and species composition. A simple, rapid procedure for obtaining this description was developed, comprising a ten-point scale derived from ecologic, developmental, hydraulic, and taxonomic considerations. A numerical rating, a descriptor category, and more detailed characterization are presented in a table. Detailed botanical knowledge is not required to utilize this classification scale. In addition, the vertical growth is quantified on a five-point scale and the horizontal growth (percent coverage of the water surface) on a nine-point scale. Tests of application revealed that this system required only a few minutes per application site, gave fairly constant evaluations for similar vegetation patterns on different water bodies, and permitted recognition of variation due to hydromorphological character, local changes in ecological factors, and seasonal patterns. Mapping using this system is also possible. Comparison with dry weight determinations at the same three recording points on three different dates showed that neither of these two procedures is ideal for all situations. However, the simplicity of the rating method means that larger numbers of assessments can be performed and the effects of random fluctuations minimized. (Carroll-FRC)
W82-05092

A PORTABLE SYSTEM FOR MEASURING WATER TEMPERATURE, CONDUCTIVITY, DISSOLVED OXYGEN, LIGHT ATTENUATION AND DEPTH OF SAMPLING,
Nature Conservancy, Grange-over-Sands (England). Merlewood Research Station.
D. G. Benham, and D. G. George.
Freshwater Biology, Vol 11, No 5, p 459-471, 1981. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Temperature, Monitoring, *Water quality, *Specific conductivity, Dissolved oxygen, Sample preparation, Sampling, Water sampling, Water analysis.

A description is offered of equipment designed to overcome the inconvenience of handling several specialized instruments for monitoring water temperature by incorporating all the sensing circuits into one self-contained unit. The system is powered by a rechargeable battery pack and provides instantaneous digital readings of temperature, conductivity, dissolved oxygen, light attenuation and depth of operation. Most of the measuring circuitry is of a novel design and incorporated selected, temperature-tested components to improve sensitivity and increase stability. The instrument can also provide continuous time-records of each variable, or X-Y plots of selected variables against depth, when connected to suitable chart recorders. The prototype instrument was tested extensively in the field over a three year period and has proved reliable in a wide range of applications, Results are presented to demonstrate the use of the temperature and depth transducers in X-Y mode, the use os the temperature/conductivity probe in flow-through mode, improvement in response time gained by fitting a water circulator to the oxygen electrode, and the use of the light-ratio meter as a crude transmisso-meter. (Baker-FRC)
W82-05105

SIMPLIFYING NEUTRON MOISTURE METER CALIBRATION,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
F. S. Nakayama, and R. J. Reginato.
Soil Science, Vol 133, No 1, p 48-52, January, 1982. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Moisture meters, *Calibrations, *Soil moisture meters, Nuclear moisture meters, Measuring instruments, Absorption.

A method is described for relating measurements of different neutron moisture meters with each other and using the relationships developed for calibrating other meters. The four neutron moisture meters used include a source strength mCi model, probe model, absorber-shield type, and scaler model. Soil moisture probes can be calibrated in the field by comparing them directly with a master reference probe, using the appropriate type of access tubing and covering a range of water contents. Plastic absorbers can be used as secondary standards and also for checking the performance of the individual probes. A whole series of interrelations between plastic absorbers and different soil types may be developed, to which the manufacturer or user could refer in obtaining a calibration curve suitable for the field site. Of the four methods compared, the simplest was found to be that of calibrating one master probe and comparing other probes with this under field conditions which were similar over a range of soil water contents. From the slope and intercept values which can be obtained, a reference regression equation can be developed that can be used to calibrate other probes in the laboratory. (Baker-FRC)
W82-05173

HANDLING AND MEASUREMENT TECHNIQUES FOR ANOXIC INTERSTITIAL WATERS,
Freshwater Biological Association, Windermere (England).
W. Davison, C. Woof, and D. R. Turner.
Nature (London), Vol 295, No 5850, p 582-583, February 18, 1982. 2 Fig, 23 Ref.

Descriptors: *Interstitial waters, *Measuring instruments, Chemical analysis, Water analysis, Polarography, *Iron, *Magnanese, *Sulfides.

A new method is presented for measuring Fe(II), MN(II) and sulfide ions in the interstitial waters of anoxic sediments which have been sampled using a simple corer. Rapid filtration directly into a polarographic vessel permits the extraction of interstitial water and the measurement of all three components, less than 5 minutes after subsampling the sediment. The non-destructive polarographic measurement is able to assess the extent of contamination by oxygen and to study subsequent reactions in the interstitial water. Because polarography is a nondestructive technique, any change may be continuously monitored on the same sample. Polarograms were made of the overlying lake water of Esthwaite Water, interstitial water of Esthwaite Water and interstitial water of Rostherne Mere. The interstitial water samples were taken from a sediment depth of 3-4 cm. The results for the overlying water were in good agreement with earlier studies. The interstitial waters seemed to exhibit a reduced solubility and, because the solid phase had more opportunity to age in the sediment than in the anoxic waters of the lake, support is given to the supposition that the aging solid phase controls the interstitial water concentrations. The method should be applicable to organic rich marine sediments. Because anodic stripping voltammetry uses the same equipment, this simple procedure could be used to measure trace metals in interstitial water. (Baker-FRC)
W82-05176

ENTRAINMENT MORTALITY OF ICHTHYOPLANKON: DETECTABILITY AND PRECISION OF ESTIMATES,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W82-05181

MICROCOMPUTER WATER QUALITY SIMULATION MODEL,
Camp, Dresser and McKee, Inc., Waltham, MA.
R. J. Hughto, and R. P. Schreiber.
Civil Engineering (New York), Vol 53, No 3, p 58-59, March, 1982. 2 Fig.

Descriptors: *Water quality, *Rivers, *Computers, Model studies, Mathematical models, Simulation analysis, *Fate of pollutants, Biological oxygen demand, Dissolved oxygen, Aberjona River, Massachusetts.

A water quality model computes concentrations of dissolved oxygen, BOD, and nitrogenous oxygen demand in a river or stream. Assumptions are: the river is divided into a series of reaches with uniform characteristics, steady-state conditions prevail, concentrations of dissolved oxygen, etc., and inflow rates are known at the upstream boundary and at all inflow points, longitudinal dispersion is negligible, and all variations occur in one dimension. The model program is listed with a sample run for a three-reach system. The program is interactive, prompting the user to input the parameters for each reach. The system was tested on the Aberjona River basin, Boston, Massachusetts, to obtain a preliminary analysis of the effect of existing pollutant sources on water quality and to predict the results of abatement measures. (Cassar-FRC)
W82-05191

A WIND-POWERED, GROUND WATER MONITORING INSTALLATION AT A RADIOACTIVE WASTE MANAGEMENT SITE IN IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05233

A RELIABLE DISSOLVED OXYGEN PROBE FOR WASTE WATER TREATMENT PLANTS,
J. M. Hale.
Water and Waste Treatment, Vol 25, No 1, p 35-36, January, 1982. 3 Fig.

Descriptors: *Measuring instruments, *Wastewater analysis, *Dissolved oxygen, Oxygen, Monitoring, *Wastewater treatment, Orbisphere Laboratories, Control systems, Aeration, Sensors.

An oxygen detecting system was developed for use under the harsh conditions encountered in a wastewater treatment plant aeration basin. Orbisphere Laboratories' Model 2716 overcomes some of the problems normally encountered in dissolved oxygen sensors. The features include: (1) low flow requirements (1 cm per sec produces 95% of the high-flow limit and 29 cm per sec, 99%), (2) no interference from entangled fibrous material, (3) strong teflon membrane, cleanable with a toothbrush, (4) very tight stable seal between membrane and sensor body, (5) insensitivity to hydrogen sulfide, and (6) solid state digital electronic construction. In a 60-day test in a wastewater plant aeration basin no maintenance of the probe was necessary. Differences between the Model 2716 results and those from a test probe were always less than the 0.23 ppm error inherent in the test probe. (Cassar-FRC)
W82-05248

SAMPLING FREQUENCY OPTIMIZATION USING A WATER QUALITY INDEX,
Oregon State Dept. of Environmental Quality, Salem.
For primary bibliographic entry see Field 5A.
W82-05268

AUTOMATED BIOMONITORING APPLICATIONS IN REMOTE WATER QUALITY SURVEILLANCE AND TIME RATED TOXICOLOGICAL ASSAY,
Tennessee Technological Univ., Cookeville. Dept. of Biology.
E. L. Morgan, and K. W. Eagleson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224809,

Price codes: A04 in paper copy, A01 in microfiche. Research Report 86, April 1981. 51 p, 14 Fig, 5 Tab, 26 Ref. OWRT A-060-TENN, 14-34-0001-0145.

Descriptors: *Remote sensing, *Satellite technology, *Water quality, *Automation, *Data transmission, Sensors, Telemetry, Monitoring, Toxicity, Mortality, Respiration, Detection times, Computers, Buoys, Data collections, Bioindicators, Streams, Rivers, Water pollution, Stream pollution.

Applications of remote water quality platforms at key locations in selected drainages are becoming increasingly important for water quality assessment. Testing was made of remote site-specific biosensing units for real-time water quality monitoring from cold water streams in the Great Smoky Mountains National Park to a warm water site on the Tennessee Cumberland River. The designed sensors monitored fish respiratory responses. The sensors were interfaced to existing water quality monitoring stations equipped with remote microprocessor-controlled data collection platforms. Biological responses and physical parameters were transmitted from the stations to over-passing earth satellites which retransmitted the data to a central data collection and processing center. These applications provided verification that real-time biological responses can be remotely monitored and simultaneously retrieved with physical water quality information via radiotelemetry systems. Laboratory prototypes of an automated toxicity assay monitor and a buoy system were also studied for remote biosensing applications. The toxicity monitor was tested and verified in a series of time-rated mortality studies, and the buoy configuration was found to be effective. (Zielinski-MAXIMA)
W82-05305

A FIELD TECHNIQUE TO DIRECTLY MEASURE RIVER BANK EROSION,
Alberta Research Council, Edmonton.
H. R. Hudson.
Environment, Vol 24, No 3, p 381-383, April, 1982. 1 Fig, 14 Ref.

Descriptors: *Rivers, *Erosion, Mathematical studies, *Measuring instruments, *Bank erosion, Monitoring, Sediment transport.

A new method is presented for evaluating the mode and spatial and temporal aspects of bank erosion. The method calls for sequential bank profiling from a fixed baseline using a stadia rod for vertical control and another stadia rod, Brunton compass, and meter rule for horizontal control. The method yields a rapid, accurate representation of river bank changes, using inexpensive, readily available equipment. When repeat surveys are performed at a relatively close spatial interval, which depends on the complexity of the bank, a three dimensional map of the bank may be drawn and volumetric changes may be calculated. These surveys should be supported by a photographic record of the profile sites. The time required to produce a single profile for a complex bank of 2 meters in height is about 5 minutes. Repeat surveys show that the precision of the technique is within 5 cm for a complex bank and difficult conditions. The accuracy and precision of measurement improve with less complex banks. The major limitations are access to the base of the bank and up the bank and ability to define sufficient relevant points in the cross section to accurately describe the bank. It is suggested that the technique may provide details of bank erosion of intermediate magnitude over periods of days to years. (Baker-FRC)
W82-05410

SPECTRAL REFLECTANCES OF FRESHWATER ICE AND SNOW FROM 340 THROUGH 1100 NM,
For primary bibliographic entry see Field 2C.
W82-05556

HUMIDITY MEASUREMENT BY INFRARED THERMOMETRY,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
S. B. Idso.
Remote Sensing of Environment, Vol 12, No 1, p 87-91, 1982. 2 Fig, 12 Ref.

Descriptors: *Vapor pressure, *Air temperature, *Humidity, Temperature, Water vapor, Infrared Thermometry, Thermometers, Water stress, Remote sensing, Measuring instruments.

Humidity measurements necessary for remote sensing of plant water stress were performed with a new technique. The same infrared thermometer used to measure foliage temperature was used to obtain the vapor pressure measurement by viewing the cloudless sky directly overhead. Both the brightness temperature at 10.5-12.5 microns and the air temperature readings were obtained simultaneously and the values inserted into equations to calculate vapor pressure. A graph of calculted vs. measured vapor pressure obtained over a year's work showed deviations from the 1:1 line of + or - 3 mb for all but the lowest vapor pressures, which showed deviations of + or - 6 mb. The deviations were most prevalent in hot dry summer conditions and cool dry winter conditions. The method can be used in partly cloudy weather if the zenith is clear. (Cassar-FRC)
W82-05611

GEOTECHNICAL APPLICATIONS OF LANDSAT IMAGE ANALYSIS OF BHAKRA DAM RESERVOIR, INDIA,
Indian Inst. of Tech., Bombay. Centre of Studies of Resources Engineering.
For primary bibliographic entry see Field 7C.
W82-05612

DIRECT SNOW-WATER EQUIVALENT MEASUREMENTS BY AIR-BORNE GAMMA-RAY SPECTROMETRY,
Geological Survey of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 2C.
W82-05643

ESTIMATION OF ISOTOPIC EXCHANGE PARAMETERS, USING CONSTANT-FEED PANS,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2D.
W82-05648

A LAND RESOURCE INFORMATION SYSTEM (LRIS) FOR WATER QUALITY MANAGEMENT IN THE LAKE ERIE BASIN,
Corps of Engineers, Buffalo, NY.
J. R. Adams, T. J. Logan, T. H. Cahill, D. R. Urban, and S. M. Yaksich.
Journal of Soil and Water Conservation, Vol 37, No 1, p 45-50, January/February, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Maps, *Information systems, *Water quality management, Land use, Lake Erie Basin, Soil properties, Watershed management, Cultivation, Land Resource Information System, Data collections, Sediment transport, Phosphorus, Nonpoint pollution sources.

A Land Resource Information System (LRIS) was devised by the U.S. Army Corps of Engineers Lake Erie Wastewater Management Study (LEWMS) for water resources planning in the Lake Erie Basin. LRIS is a variable size (4-36 ha) system which encodes each cell for each parameter at a randomized point location within each cell. Information included is land use or cover, soil characteristics, and political and hydrological boundaries. Data were supplied from several agencies and previous studies. The LRIS can produce maps or tables. Color maps can be developed for the entire basin or any division down to the township level. These maps clearly show soil types, crop intensity, soil texture, and slope. Data from LRIS can be used in the ANSWERS model to simulate sediment and phosphorus transport under different conservation practices. (Cassar-FRC)
W82-05662

RECORDING RAINGAGE MODIFICATIONS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
J. D. Greer.
Journal of Soil and Water Conservation, Vol 37, No 1, p 63-64, January/February, 1982. 2 Fig, 1 Ref.

Descriptors: *Rain gages, *Charts, *Measuring instruments, Precipitation, Rainfall, Experimental design.

Evaporation from a rain gage was minimized by installing a U-trap, similar to a lavatory drain trap, between the collecting funnel and the 5-quart jar with screw-on top. A small hole in the top relieved air pressure as rainwater flowed into the container. No evaporation from the rain gage between storms was evident. An FW-1 type water stage recorder was modified to record rain days for one month. A tipping bucket was constructed to indicate the date of rainfall starts and stops on a recording chart. (Cassar-FRC)
W82-05665

NORMALITY OF HYDROLOGICAL DATA,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, A. Sunchindah, and D. Patnaik.
Water Resources Bulletin, Vol 18, No 1, p 37-42, February, 1982. 6 Tab, 24 Ref.

Descriptors: *Hydrologic data, *Statistical analysis, Mathematical studies, *Stochastic process, Hydrologic models, Analysis of variance, Probabilistic process.

Although the normal distribution plays an important role in stochastic hydrology in which statistical techniques have been extensively employed, the assessment of the normality of hydrological data has been based largely on subjective judgments. Three computationally simple statistical tests are suggested for assessing the normality assumption with respect to hydrological sequences. Statistical tests for normality include standard moment ratios, analysis of variance tests, and tests based on probability plots. These statistical tests were applied to monthly and annual stream flow data from six stations to assess the validity of the assumption that these data, their square roots or logarithms are normal. This analysis showed that, for the stream flow data used, at least one of the three annual sequences (original, square root, and logarithmic) can be treated as normal; monthly stream flows cannot always be represented by normal distributions; and the square root and logarithmic transformations cannot render all the 12 monthly stream flow sequences normal. These results indicate that different transformations may be required for different months and that the assumption of normality for monthly stream flows under only one of the two transformations is less realistic. (Carroll-FRC)
W82-05752

ON HYDROLOGICAL DATA NEEDS IN CANADA,
British Columbia Univ., Vancouver. Dept. of Geography.
M. Church, and R. Kellerhals.
Canadian Water Resources Journal, Vol 5, No 4, p 1-24, 1980. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Data collections, Water management, *Streamflow, *Hydrologic data, *Canada, Rivers, Ice, Glacial streams, Stream gages, Gaging stations, Channel morphology, Sediments, Regional analysis, Data interpretation, Planning.

Canada's abundant surface water resources are different in some respects (extreme temperatures, highly seasonal runoff, postglacial topography, and gravel beds) from rivers in other parts of the world for which much hydrologic data has been collected and studied. Present sources of data for Canada rivers are stream gaging stations, engineering histories, and special studies. Existing data must be presented in more usable form, for example, listing data not by calendar year but by a period suitable for the hydrologic conditions, tabulation of extreme streamflows by type, routine frequency anal-

ysis by a central group, flow probability and flow duration summaries, indication of long-term trends, a central source for all data summaries, and indication of precision of data. Development of a hydrological data base should include more reliable and sophisticated stream gaging equipment, a systematic program to study ice formation and decay and problems caused by ice, documentation of river channel morphology, field studies of extreme events and biophysical processes, compilation of regional knowledge, and extension of suspended sediment monitoring sites. Suggestions are given for educational and institutional changes necessary to implement these changes in hydrological data collections. (Cassar-FRC)
W82-05764

TELEMETRY AND REAL TIME ENVIRONMENTAL DATA ACQUISITION (LA TELEMETRIE ET L'ACQUISITION EN TEMPS REEL DES DONNEES SUR L'ENVIRONNEMENT),
C. Pesant.
Canadian Water Resources Journal, Vol 5, No 4, p 25-39, 1980. 4 Fig, 3 Tab. English abstract.

Descriptors: *Remote sensing, *Telemetry, *Data acquisition, Satellite technology, Data collections, Hydrologic data collections, Quebec, Monitoring, Computers, Forecasting.

Quebec's telemetry network, which dates back to 1977, consists of 100 stations for collection of meteorological and hydrologic data. Communication in the system is by telephone lines in urban and rural areas and by the satellite GOES in more remote regions. A minicomputer, Nova 4, coordinates data acquisition and dissemination. Average efficiencies of the 100 stations were 96-99% during the year starting September 1979. Objectives of the network are to inventory surface waters and climate, to forecast water levels, to aid in design of reservoirs and hydroelectric stations, and to protect forests. Users of the information include Environment Quebec, Quebec Energy and Resources, James Bay Energy Society, and Alcan Canada Limited. (Cassar-FRC)
W82-05770

ROLE OF THE MICROCOMPUTER IN WATER MANAGEMENT,
Canadian Applied Technology, Buttonville, Ontario.
A. Tailor.
Canadian Water Resources Journal, Vol 5, No 2, p 28-37, 1980. 2 Fig, 4 Ref.

Descriptors: *Water management, *Computers, *Data collections, Measuring instruments, Automation, Control systems, Decision making, Monitoring, Streamflow forecasting, Information systems, Remote sensing.

The microcomputer has many possible functions in water management: data processing; automatic data collection; communication with other computers by telephone, radio, or satellite; selection of time intervals; monitoring water resources (ice formation and dissipation, resources management, flood warning, and flow forecasting); and remote data acquisition. The microcomputer can provide current information necessary for decision making in water management. Limitations are not in the computers but in automatic, reliable measuring instruments for the parameters of interest. (Cassar-FRC)
W82-05771

INFLUENCE OF DISSOLVED ORGANIC MATERIALS ON TURBID WATER OPTICAL PROPERTIES AND REMOTE-SENSING REFLECTANCE,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2K.
W82-05869

ON THE SAMPLING VARIANCE OF RAINGAGE NETWORKS,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
B. A. Silverman, L. K. Rogers, and D. Dahl.
Journal of Applied Meteorology, Vol 20, No 12, p 1468-1478, December, 1981. 3 Fig, 5 Tab, 24 Ref.

Descriptors: *Rainfall distribution, *Measuring instruments, Model studies, Variability, Rainstorms, Precipitation rate, Precipitation.

The sampling variance of raingage networks is examined, and this variance is related quantitatively to both the density of raingages and the characteristics of the isohyetal pattern. The variance due to sampling results from the necessity of estimating areal rainfall values from point measurements of a storm footprint that contains spatial gradients. This is especially true for convective storms. Depending on how a storm passes over the gage network, the precipitation is usually either under-or overestimated. A computer model of raincell isohyetal patterns is used to assess the sampling variance. The coefficient of variation was found to increase with decreasing gage density and increasing precipitation gradient. Contrary to the sampling error studies of other investigators, it was found that the mean precipitation remained unbiased as the gage density decreased, but its standard deviation increased. The theoretical isohyetal patterns were then related to observed isohyetal maps and the characteristics of their structure. The observations suuggested a tendency for the precipitation gradient to be steepest, increasing rapidly toward the storm precipitation maximum, in short-duration convective storms of small areal extent. More uniform precipitation gradients tend to be found in steady type rains and large, long-lasting storms. Expressed in terms of the percentage of storm area containing 50% of the precipitation volume, the precipitation gradient varied from 15 to 30%. It was also found that convective raincell patterns tended to be elliptical in shape. (Baker-FRC)
W82-05875

7C. Evaluation, Processing and Publication

LINEBORO QUADRANGLE: HYDROGEOLOGY,
Geological Survey, Towson, MD. Water Resources Div.
M. T. Duigon, E. G. Otton, and J. T. Hilleary.
Maryland Geological Survey Quadrangle Atlas No 13, 1981. 5 Sheets, 5 Maps, 6 Fig, 30 Ref.

Descriptors: *Maps, *Geohydrologic units, *Groundwater, Water use, Land use, Percolation rate, Precipitation, Wells, Springs, *Water table, *Groundwater availability, Water supply, Effluents, Underground waste disposal, *Maryland, Lineboro quadrangle, Baltimore County, Carroll County.

This series of map atlases for the Lineboro quadrangle in Baltimore and Carroll Counties, MD., is designed to aid county, State, and Federal officials, engineers, land developers, and the general public in the wise use of the water and land resources. The maps and associated text show the location of several hundred wells and a few springs, the approximate depth to the water table, the availability of groundwater supplies, and geohydrologic conditions pertaining to shallow underground disposal of domestic sewage. (USGS)
W82-04969

HYDROLOGIC DATA OF THE SHAWSHEEN RIVER BASIN, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
F. G. Gay, and D. F. Delaney.
Massachusetts Hydrologic-Data Report No 22, 1981. 22 p, 1 Plate, 5 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Groundwater, Test wells, Well logs, Water level, Chemical analysis, *Massachusetts, *Shawsheen River basin, Borings.

The Shawsheen River basin drains a 77-square-mile area into the Merrimack River. The basin is northwest of the Boston metropolitan area in eastern Massachusetts within Essex and Middlesex Counties. This report contains hydrologic data for all, or parts of, the cities and towns of Andover, Bedford, Billerica, Burlington, Concord, Lawrence, Lexington, Lincoln, North Andover, Tewksbury, Wilmington, and Woburn. Information in this report includes well, test-well, and boring data; chemical analyses of ground water complied from 1972 to 1974; and a list of publications containing ground-water-level records. (USGS)
W82-04970

GROUNDWATER RESOURCES OF THE WILLIAMSPORT REGION, LYCOMING COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04971

GROUNDWATER AND GEOLOGY OF THE CUMBERLAND VALLEY, CUMBERLAND COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div., and Esso Prospeccao Limitada, Rio de Janeiro, Brazil.
For primary bibliographic entry see Field 2F.
W82-04972

GROUNDWATER RESOURCES OF THE GETTYSBURG AND HAMMER CREEK FORMATIONS, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04973

HYDROGEOLOGIC DATA COLLECTED FROM THE KISSIMMEE PLANNING AREA, SOUTH FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. E. Reece, R. Belles, and M. P. Brown.
South Florida Water Management District Report, 1981. 192 p, 3 Fig, 6 Tab, 31 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, *Water management, Aquifers, *Geohydrology, Potable water, Water use, Wells, Water level, Well logs, Specific capacity, Water analysis, *Florida, Kissimmee, Floridan aquifer.

The Floridan aquifer is the primary source of potable water in the populated northern part of the Kissimmee Planning Area of central Florida and the major source of water for agricultural use throughout the area. Because of the importance of the Floridan aquifer in the area, a reconnaissance study was conducted to collect data necessary to describe the geology, hydrologic properties, and water quality of the aquifer. This report contains the following data: well descriptions for 130 wells; water-level measurements for 122 wells; water-level hydrographs for 7 wells; geologic descriptions of drill cuttings for 7 wells; and geophysical logs for 43 wells. (USGS)
W82-04974

HYDROLOGIC DESCRIPTION OF LAKE JACKSON, SEBRING, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
K. M. Hammett.
Geological Survey Open-File Report 81-494 (WRI), 1981. 1 Sheet, 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Lakes, *Limnology, *Lake morphometry, *Hydrologic budget, Lake stages, Hydrologic data, Surface-groundwater relations, Bathymetry, Water quality, Chemical analysis, *Florida, Sebring, *Lake Jackson.

Available data were evaluated to document hydrologic conditions in the Lake Jackson basin, Florida. Bathymetric data indicate numerous dredged

holes around the perimeter of the lake. Away from the dredged holes, a firm sand bottom slopes gradually from the shore to a maximum depth of 22 feet. Lake Jackson's stage declined 3 feet from 1970 to 1973 and has remained below normal since that time. Rainfall was below average from 1970 to 1973, but the lake-level decline did not result solely from deficient precipitation. A water-budget analysis of the lake indicates that channelization downstream and groundwater withdrawals contributed significantly to the decline. Lake Jackson is used extensively for recreation. Available water-quality data indicate suitable conditions for recreation and the propagation and management of fish and wildlife. (USGS)
W82-04975

HYDROLOGIC MONITORING IN THE COAL FIELDS OF CENTRAL UTAH, AUGUST 1978-SEPTEMBER 1979,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-04976

HYDROLOGY OF THE WINTER HAVEN CHAIN OF LAKES, POLK COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair, and R. C. Reichenbaugh.
Geological Survey Open-File Report 81-212 (WRI), 1981. 1 Sheet, 12 Fig, 1 Tab, 3 Ref.

Descriptors: *Lakes, Lake basins, Lake stages, *Limnology, Bathymetry, Geohydrology, Hydrologic data, Rainfall, Surface-groundwater relations, Pumpage, Aquifers, Water level, Hydrographs, Maps, *Florida, *Polk County, *Winter Haven Chain of Lakes, Floridan aquifer.

Fourteen interconnected lakes in and around the city of Winter Haven, Polk County, Fla., form the Winter Haven Chain of Lakes. Levels of the lakes during the spring of 1976 were at a record low stage for the 31 years of record. During 1960-76, rainfall had been below average for all but 2 years, and departure from average rainfall totaled 72.34 inches. Fluctuations in stage of Lake Howard, representative of the chain, and of Lake Otis, the nearest isolated lake that has a reasonably long record of stage, were compared with other hydrologic variables. Analyses of lake stage and rainfall records indicate that deficient rainfall has been the key factor in the decline of lake levels in the area. Manipulation of lake levels, pumpage from the lakes and underlying aquifer, and urbanization of the watershed probably have affected the lakes as well, but records are not available to determine the significance of their effects. The surficial aquifer drains to the lakes. Water level in the underlying Floridan aquifer is everywhere lower than in any of the lakes, thus water moves from the lakes and surficial aquifer through the confining clay layer to the Floridan aquifer. (USGS)
W82-04977

MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER, MAY 19-23, 1980,
Geological Survey, Towson, MD. Water Resources Div.
F. Chapelle, D. Drummond, and T. Curley.
Available from the OFSS, USGS Box 25425, Fed Ctr., Denver, CO 80225. Price: $1.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-416, 1981. 1 Sheet.

Descriptors: Maps, *Potentiometric level, *Aquifers, *Observation wells, Groundwater level, Coastal plains, *Maryland, *Aquia aquifer.

The map is based on water level measurements made May 19-23, 1980. The well network used included 83 wells which have been screened in the Aquia aquifer (Aquia Formation of Paleocene Age). Highest levels of the potentiometric surface, 20 to 35 feet above sea level, were measured near the outcrop or subcrop of the aquifer in the topographically high areas of Anne Arundel and Prince Georges Counties. The potentiometric surface slopes to the southeast. Four separate and extensive cones of depression have developed in the potentiometric surface in the vicinities of Lexington Park, Leonardtown, Prince Frederick, and Chesapeake Beach. The cones of Leonardtown and Lexington Park seem to be merging. (USGS)
W82-04978

DERIVATION OF HOMOGENEOUS STREAMFLOW RECORDS FOR THE GREEN RIVER BASIN, KENTUCKY,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04979

BASE FLOW OF STREAMS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-79,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04980

LITTLETOWN QUADRANGLE: HYDROGEOLOGY,
Geological Survey, Towson, MD. Water Resources Div.
J. M. Weigle, and J. T. Hilleary.
Maryland Geological Survey Quadrangle Atlas No. 14, 1981. 5 Sheets, 5 Maps, 3 Fig, 30 Ref.

Descriptors: *Maps, *Geohydrologic units, *Groundwater, Water use, Land use, Percolation rate, Precipitation, Wells, Springs, Water table, Groundwater availability, Water supply, Effluents, Underground waste disposal, *Maryland, Littletown quadrangle, *Carroll County.

The maps in the atlas for the Littletown quadrangle in Carroll County, Md., are designed to aid specialists and the general public in planning the use of water and land resources. The maps show locations of wells and springs, approximate depth to the water table, availability of ground water, and geohydrologic conditions pertaining to shallow underground disposal of domestic sewage. (USGS)
W82-04984

INDEX TO WATER-RESOURCES DATA FOR LOUISIANA, SURFACE-WATER RECORDS, WATER-QUALITY RECORDS.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Louisiana Department of Public Works Water Resources Basic Records Report No 10, 1981. 138 p, 3 Tab, 11 Ref.

Descriptors: *Data collections, *Surface water, *Water quality, Streamflow, Gaging stations, *Louisiana.

This index is a tabulation of descriptive information for all sites in Louisiana where streamflow or water-quality data have been collected by the U.S. Geological Survey, in cooperation with local, State, and Federal agencies, through September 30, 1980. (USGS)
W82-04985

GROUND-WATER HYDROLOGY OF JEFFERSON COUNTY, WEST VIRGINIA,
Geological Survey, Morgantown, WV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04986

COMPILATION OF HYDROLOGIC DATA FOR THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS, 1934-79.
Geological Survey, San Antonio, TX. Water Resources Div.
Edwards Underground Water District Bulletin 39, October, 1981. 133 p, 4 Fig, 8 Tab, 82 Ref.

Descriptors: *Hydrologic data, *Aquifers, *Groundwater, Groundwater recharge, Wells, Springs, Discharge measurement, Water level, Groundwater storage, Water sampling, Water quality, Texas, *San Antonio area, *Edwards aquifer.

The average annual ground-water recharge to the Edwards aquifer in the San Antonio area, Texas, from 1934 through 1979, was 598,800 acre-feet. The recharge in 1979 was 1,117,800 acre-feet, which was the fifth highest estimated recharge since 1934. A maximum annual recharge of 1,711,200 acre-feet occurred in 1958, and a minimum annual recharge of 43,700 acre-feet occurred in 1956. The estimated annual discharge by wells and springs in 1979 was 914,500 acre-feet. A maximum annual discharge of 960,900 acre-feet occurred in 1977, and a minimum annual discharge of 388,800 acre-feet occurred in 1955. During 1979, water levels in wells in the Edwards aquifer fluctuated near record highs; consequently, the volume of ground water in storage in the aquifer also was near the record high. Analyses of water samples from 77 wells and 3 springs show no evidence of significant degradation of water quality in the Edwards aquifer, and the data show no trend of degradation in water quality. (USGS)
W82-04987

FLOOD AND DEBRIS FLOOD HAZARDS MAP, CARSON CITY QUADRANGLE,
Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer, and C. V. Schroer.
Available from Nev. Bur. of Mines and Geo. Univ. of Nevada Reno, Nevada 89557, Price: $2.50. Nevada Bureau of Mines and Geology Map 1A1, 1981. 1 Sheet.

Descriptors: *Maps, *Floods, *Detritus, *Hazards, Flood peak, Flood plains, Flood flow, Erosion, Deposition, *Nevada, *Carson City quadrangle.

This map shows the flood and debris hazards on the Carson City quadrangle, Nevada. Estimates of the 100-year floodflow were made and the corresponding flood plains were outlined on the map for the principal drainages in the area. Degrees of hazard were assigned to the flood plains of these streams on the basis of floodflows and potential debris movement. (USGS)
W82-05217

TEST-HOLE DATA FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS,
Geological Survey, Houston, TX. Water Resources Div.
T. A. Small, and R. W. Maclay.
Texas Department of Water Resources LP-171, January 1982. 153 p, 9 Fig, 38 Tab, 21 Ref.

Descriptors: *Test holes, *Core drilling, *Aquifers, Data collections, Porosity, Permeability, Mineralogy, Water management, *Texas, San Antonio area, *Edwards aquifer, *Geohydrology.

This report contains descriptive geologic data collected by the U.S. Geological Survey during a test-hole program to develop a factual concept of the distribution of porosity and permeability within the framework of the Edwards aquifer in the San Antonio area, Texas. The test-hole program produced more than 4,000 feet (1,219 meters) of rock core from eight holes during May 1972 to April 1974. The selection of test-hole sites was based on considerations of possible water management problems, geologic conditions, and the limitations of the drilling and coring equipment. Cores were examined for composition, color, hardness, grain size, grain type, sedimentary structure, pore shape and size, and total porosity. Laboratory tests were used to determine porosity, pore-size distribution, permeability, grain density, formation factor, and mineralogy. (USGS)
W82-05218

BEDROCK AQUIFERS IN THE LOWER DIRTY DEVIL RIVER BASIN AREA, UTAH, WITH

SPECIAL EMPHASIS ON THE NAVAJO SANDSTONE,
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. W. Hood, and T. W. Danielson.
Available from Utah Dept. of Natural Res. Div. of Water Rights 1636 West North Temple Room 220 Salt Lake City, Utah 84116. Utah Department of Natural Resources Technical Publication No 68, 1981. 143 p, 22 Fig, 4 Plates, 14 Tab, 48 Ref.

Descriptors: *Bedrock, *Aquifers, *Aquifer characteristics, *Surface-groundwater relations, Precipitation, Rainfall disposition, Hydrologic budget, Wells, Well logs, Water level, Well yields, Groundwater recharge, Groundwater movement, Groundwater storage, Water quality, Chemical analysis, Salinity, *Utah, *Dirty Devil River basin, Navajo Sandstone.

The lower Dirty Devil River basin area in southeastern Utah has an area of about 4,300 square miles. Precipitation is the main source of water and averages 1.55 million acre-feet annually in the long term. Rocks in the area range from Precambrian to Holocene. The section of sedimentary rocks ranges from 7,300 to 23,000 feet in thickness. Major aquifers are the Entrada, Navajo, Wingate, and Coconino Sandstones and rocks of Mississippian age. They contain fresh to briny water. Their permeability is affected by folding, faulting, and igneous intrusion. The annual water supply averages 1.6 million acre-feet, of which an estimated 96% is consumed by evapotranspiration. The estimated long-term annual gross ground-water recharge is 34,000 acre-feet, of which 5,000 acre-feet recharges the Navajo Sandstone. Recoverable fresh to moderately saline water stored in the Navajo, Wingate, and Coconino Sandstones is estimated to be 210 million acre-feet, of which 89 million acre-feet is stored in the Navajo alone. Long-term withdrawals from the Navajo Sandstone, of up to 12,000 gallons per minute, probably would diminish the flow of the Dirty Devil River, but would have a negligible effect on the volume of ground water in storage or the flow of the Colorado River. (USGS)
W82-05220

HYDROLOGIC RECONNAISSANCE OF THE SOUTHERN GREAT SALT LAKE DESERT AND SUMMARY OF THE HYDROLOGY OF WEST-CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. S. Gates, and S. A. Kruer.
Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 71, 1981. 55 p, 4 Fig, 4 Plates, 10 Tab, 38 Ref.

Descriptors: *Hydrologic data, *Hydrologic budget, *Groundwater, *Water quality, *Surface water, Arid climates, Evaluation, Water resources development, Potential water supply, Aquifer characteristics, Groundwater movement, Water storage, Wells, Springs, Well data, Chemical analysis, *Utah, *Great Salt Lake Desert, West-central Utah.

The report is the last of 19 hydrologic reconnaissances of the basins in western Utah. The purposes of this series of studies are (1) to analyze available hydrologic data and describe the hydrologic system, (2) to evaluate existing and potential water-resources development, and (3) to identify additional studies that might be needed. Part 1 of the report gives an estimate of recharge and discharge, an estimate of the potential for water-resources development, and a statement on the quality of water in the southern Great Salt Lake Desert part of west-central Utah. Part 2 deals with the same aspects of west-central Utah as a whole. Part 2 also summarizes the evidence of inter-basin groundwater flow in west-central Utah and presents a theory for the origin of the water discharged from Fish Springs. Annual ground-water recharge is about 241,000 acre-feet in west-central Utah and about 84,000 acre-feet in the southern Great Salt Lake Desert. Annual ground-water discharge is about 259,000 acre-feet from west-central Utah and about 84,000 acre-feet from the southern desert. Ground water in west-central Utah ranges from fresh in unconsolidated fill under the margins of the basins bordered by higher mountain ranges to briny under the mud- and salt-flat areas. About 17.4 million acre-feet of ground water, of which possibly two-thirds is fresh, is stored in the upper 100 feet of saturated basin fill in west-central Utah. Ground water flows into west-central Utah and between basins through consolidated rock. Most of the 26,000 acre-feet per year discharged at Fish Springs probably is recharged along the flanks of the Deep Creek Range and moves as interbasin flow through Snake Valley and possibly Tule Valley to Fish Springs Flat. (USGS)
W82-05221

CHEMICAL CHARACTER OF WATER IN THE RED RIVER ALLUVIAL AQUIFER, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
M. S. Whitfield, Sr.
Geological Survey Water Resources Investigation, Open-File Report 80-1018, 1980. 95 p, 3 Fig, 21 Plates, 5 Tab, 41 Ref.

Descriptors: *Water quality, *Groundwater, *Hydrologic data, *Chemical properties, Alluvial aquifers, Aquifer characteristics, Rainfall, *Groundwater recharge, Groundwater movement, Wells, Water level, Water yield, Chemical analysis, Pesticides, Maps, *Louisiana, *Red River Valley, Black River, Dissolved solids.

The Red River alluvial aquifer underlies 2,000 square miles in the Red River Valley of Louisiana and is the only source of fresh ground water in most of the valley. The aquifer consists mainly of sand and gravel and ranges from 40 to 150 feet in thickness. Recharge is by rainfall, by lateral movement of water from adjacent older formations, and by upward discharge from underlying aquifers. These varied sources of recharge cause both areal and vertical differences and variations in water quality. Water levels generally range from about 0 to less than 30 feet below land surface, and the aquifer is capable of yielding 1,000-2,000 gallons per minute to individual wells. Water is typically of the calcium magnesium bicarbonate type. It ranges in hardness from less than 100 to 2,300 mg/L (milligrams per liter) but generally is between 200 and 600 mg/L. Dissolved iron concentrations ranges from about 0.3 mg/L to as high as 49 mg/L but generally is 1 to 10 mg/L. Dissolved sulfate concentrations generally range from 0.5 to 50 mg/L but locally exceed 250 mg/L. The dissolved chloride concentrations typically is less than 50 mg/L but locally exceeds 250 mg/L and is as high as 4,400 mg/L in a few areas. (USGS)
W82-05228

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SAN SIMON WASH AREA, PAPAGO INDIAN RESERVATION, ARIZONA--1979,
Geological Survey, Tucson, AZ. Water Resources Div.
K. J. Hollett.
Geological Survey Water Resources Investigations Open-File Report 81-530, April 1981. 2 Sheets, 27 Ref.

Descriptors: *Maps, *Groundwater, *Water quality, *Wells, *Water level, Geohydrology, Alluvium, Water yield, Water use, Dissolved solids, Fluorides, Arsenic, Hydrographs, *Arizona, *Papago Indian Reservation, San Simon Wash.

The San Simon Wash area includes about 2,300 square miles in the Papago Indian Reservation in south-central Arizona. The area is characterized by low mountains separated by broad alluvial basins. The main water-bearing unit is the alluvium, which consists of clay, silt, sand, gravel, and small amounts of evaporite deposits. Properly constructed and developed wells in the basin fill generally yield more than 50 gallons per minute. Less than 50 gallons per minute is obtained from the crystalline and consolidated sedimentary rocks and from thin alluvial deposits in the mountains. In 1979 about 2,700 acre-feet of ground water was withdrawn for irrigation, public-supply, and livestock uses. The maps show depth to water, altitude of the water level, well depth, dissolved-solids, fluoride, and arsenic concentrations. Scale is 1:125,000. (USGS)
W82-05231

MAPS SHOWING GROUND-WATER CONDITIONS IN THE AGUA FRIA AREA, YAVAPAI AND MARICOPA COUNTIES, ARIZONA-1979,
Geological Survey, Tucson, AZ. Water Resources Div.
G. R. Littin.
Geological Survey Water Resources Investigations Open-File Report 81-804, June 1981. 2 Sheets, 13 Ref.

Descriptors: *Maps, *Groundwater, *Water level, *Wells, Geohydrology, Aquifers, Specific conductivity, Fluorides, *Arizona, Yavapai County, Maricopa County, Agua Fria area.

The Agua Fria area includes about 1,500 square miles in central Arizona. The water-bearing characteristics of the units that make up the aquifers vary greatly because of large differences in rock type and extent of fracturing. In order of decreasing yield potential, the major water-bearing units are the unconsolidated deposits, conglomerate, volcanic clastic deposits, and lake deposits. The minor water-bearing units consist of basaltic to rhyolitic volcanic rocks; and schist, gneiss, and granite. Ground-water development has been slight, and in 1978 about 3,200 acre-feet was withdrawn for irrigation, public supply, and domestic and stock uses. The maps show depth to water, altitude of the water level, well depth, and specific conductance and fluoride concentration in the water. Scale is 1:125,000. (USGS)
W82-05232

ASSESSMENT OF WATER QUALITY IN STREAMS DRAINING COAL-PRODUCING AREAS IN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05234

TECHNIQUES OF TREND ANALYSIS FOR MONTHLY WATER QUALITY DATA,
Geological Survey, Reston, VA.
R. M. Hirsch, J. R. Slack, and R. A. Smith.
Water Resources Research, Vol 18, No 1, p 107-121, February, 1982. 8 Fig, 5 Tab, 18 Ref.

Descriptors: *Water quality, *Monitoring, *Data interpretation, Statistical analysis, Trend analysis, Kendall tests, *Seasonal variation.

Three techniques (the seasonal Kendall test for trend, the seasonal Kendall slope estimator, and flow adjustment coupled with the seasonal Kendall test) are presented for identifying and quantifying monotonic trends in water quality with time. The methods overcome the difficulties produced by non-normal distribution, seasonality, flow relatedness, missing values, values below the detection limit, and serial correlation. The seasonal Kendall test for trends applies to data sets with seasonality, missing values, or values below the detection limit. The slope estimator test estimates trend magnitude. It estimates the slope of a linear trend more precisely than a regression estimator in the case of highly skewed data but less precisely where data are normal. The third procedure tests for changes over time in the relationship between constituent concentration and flow, overcoming the problems in identifying trends in water quality resulting from droughts. The flow adjusted concentration obtained can then be tested for trend by the seasonal Kendall test. These techniques eliminate subjectvie evaluation, which often concentrates on the extreme values rather than on the subtle but regular trends in the bulk of values nearer the mean. (Cassar-FRC)
W82-05344

USDA-SEA-AR-Beltsville, MD

GEOTECHNICAL APPLICATIONS OF LANDSAT IMAGE ANALYSIS OF BHAKRA DAM RESERVOIR, INDIA,
Indian Inst. of Tech., Bombay. Centre of Studies of Resources Engineering.
R. P. Gupta, and J. Bodechtel.
Remote Sensing of Environment, Vol 12, No 1, p 3-13, 1982. 5 Fig, 16 Ref.

Descriptors: *Remote sensing, *Reservoirs, *Monitoring, Bhakra Dam, India, Sutlej River, Landsat, Satellite technology, Geologic mapping, Mapping, rock properties, Water level, Geologic fractures, Drainage patterns, Water storage, Silting.

Analyses of Landsat images over the 240 m high concrete Bhakra Dam Reservoir on the Sutlej River, India, provided information on the geotechnical-structural nature of the area, reservoir monitoring, and silting hazards in the reservoir. Drainage patterns and tectonic features in the region were clearly discerned. A few well-developed lineaments run through the reservoir area, and some weakly marked structures are close to the dam site. No geologically recent structures approach the dam or reservoir. Determinations of temporal variations in lake area are most accurately done by digital processing of data from a 26 km length of stream bed which sensitively reflects lake levels. Landsat data identified 2 major silt-contributing zones in the reservoir. Both areas are characterized by low gradient slopes, wide valley sections, and mechanically weak rocks. Shales and clay-shales are found in Region A and fractures and defects in Region B. (Cassar-FRC)
W82-05612

FLOOD HAZARD MAPS AS PUBLIC INFORMATION: AN ASSESSMENT WITHIN THE CONTEXT OF THE CANADIAN FLOOD DAMAGE REDUCTION PROGRAM,
J. W. Handmer.
Canadian Water Resources Journal, Vol 5, No 4, p 82-110, 1980. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Public relations, *Maps, *Flood plains, Flood damage, Flood plain management, Flood plain zoning, Canadian Flood Damage Reduction Program, Information systems, Attitudes, Hazards, Carman, Manitoba, Oshawa, Ontario, Moosejaw, Saskatchewan, Publications, Risks, Zoning, Nonstructural alternatives.

The use of flood hazard maps as public information tools was evaluated by comparing attitudes of flood plain dwellers, commercial and industrial interests, and government officials with questionnaires and interviews. Carman, Manitoba (population 2400), Moosejaw, Saskatchewan (population 32,000), and Oshawa, Ontario (population 114,000) were chosen for the program. Results indicated that the substantially increased flood awareness among the group given flood hazard maps was not due to the maps alone but to increased publicity in all communications media. Methods of distributing maps which were not effective were passive distribution through public offices and libraries, printing copies of the maps in newspapers, and direct mailing. Although map dissemination is apparently ineffective in providing flood information to consumers, it is still a desirable practice. For maximum impact maps should involve local government officials, real estate agents, and mortgage companies. Maps should be visually striking, multicolored, and indicate each building clearly. Accompanying information should include brief, relevant explanations and mapping of a historic flood. (Cassar-FRC)
W82-05729

HYDROLOGY OF AREA 32, EASTERN REGION, INTERIOR COAL PROVINCE, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness, R. L. Miller, Z. C. Bailey, and C. Crawford.
Geological Survey Open-File Report 81-498 (WRI), August 1981. 76 p, 38 Fig, 12 Tab, 56 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Geohydrology, Hydrologic cycle, Climates, Land use, Soil classification, Indiana, Eastern region, Interior Coal Province.

Hydrologic and water-quality information from the coal region in parts of 11 counties in southwestern Indiana are summarized. Pennsylvanian and Mississippian bedrock are overlain by drift and till from the Kansan, Illinoian, and Wisconsinan glaciers that covered two-thirds of the area. Most of the coal is mined from Pennsylvanian coal units. As of 1978, more than 1-billion short tons of coal had been mined from the 11 counties. More than 12-billion short tons remained in reserve. During 1978, 17.8-million short tons were mined. Coal mining disturbs less than 1% of the land in the study area. Sixty-two percent of the land use is agricultural, and 29% is forested. More coal is mined in the southern and western parts of the study area than elsewhere. Surface water in these parts had lower pH and alkalinity than water in the north and east parts. Specific conductance and concentrations of sulfate, iron, and manganese in surface water were higher in the south and west than elsewhere. (USGS)
W82-05825

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1979 TO SPRING 1980.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-05826

MAP SHOWING GROUND-WATER CONDITIONS IN THE SACRAMENTO VALLEY AREA, MOHAVE COUNTY, ARIZONA--1979,
Geological Survey, Tucson, AZ. Water Resources Div.
C. L. Pfaff, and D. M. Clay.
Geological Survey Open-File Report 81-418 (WRI), March 1981. 1 Sheet, 7 Ref.

Descriptors: *Maps, *Groundwater, *Wells, *Water level, *Water quality, Geohydrology, Aquifer characteristics, Specific conductivity, Fluorides, Water use, Groundwater potential, Hydrographs, *Arizona, Mohave County, Sacramento Valley area.

The Sacramento Valley area includes about 800 square miles in northwestern Arizona. The valley slopes gently southward and is filled with alluvium and volcanic rocks to depths of more than 4,000 feet. The alluvium is divided into three units--older, intermediate, and younger alluvium--and the volcanic rocks are divided into two units--older and younger volcanic rocks. The older alluvium is the main water-bearing unit and yields 20 to 1,300 gallons per minute of water to wells. In the Kingman area the younger volcanic rocks are about 1,400 feet thick and yield less than 1 to 300 gallons per minute. Ground-water development has been slight and, is general, has had little effect on water levels; however, water-level declines have occurred in places where ground water is withdrawn for industrial or municipal supplies. The map shows depth to water, altitude of the water level, well depth, specific conductance, and fluoride concentration. Hydrographs of the water level in selected wells and a table of historical pumpage also are included. Scale is 1:125,000. (USGS)
W82-05827

HYDROGEOLOGIC RECONNAISSANCE OF THE REPUBLICAN RIVER BASIN IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
M. J. Ellis.
Geological Survey Open-File Report 81-531 (WRI), July 1981. 3 Sheets, 25 Ref.

Descriptors: *Maps, *Geohydrology, *Groundwater, *Aquifer characteristics, Bedrock, Water table, Water level, Water level fluctuations, Hydrologic data, *Nebraska, Republican River basin.

The Republican River basin in Nebraska includes about 9,710 square miles in the southwestern and south-central parts of the State. The principal sources of ground water in the basin are sand and gravel deposits overlying the Cretaceous bedrock. In the upland parts of the basin, these sands and gravels occur in both Pleistocene deposits and the Ogallala Formation. Along the Republican River valley the sands and gravels occur in undifferentiated Holocene and Pleistocene deposits. Information mapped includes: configuration of the Cretaceous bedrock surface and the configuration of the spring 1977 water table (scale, 1:250,000); and approximate outcrop of Cretaceous bedrock and approximate extent of White River Group (scale 1:1,000,000). (USGS)
W82-05828

CHLORIDE AND TOTAL HARDNESS CONCENTRATIONS OF WATER FROM THE UPPER PART OF THE FLORIDAN AQUIFER IN ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. S. Hampson, and E. C. Hayes.
Geological Survey Open-File Report 81-907 (WRI), 1982. 1 Sheet, 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Potentiometric level, Geohydrology, Data collections, Chlorides, Hardness, Salinity, Pumpage, Irrigation, *Florida, St. Johns County, Floridan aquifer.

Data collected from 1976 to 1979 indicate large water-quality variations in the upper 300 feet of the Floridan aquifer in St. Johns County, Florida. Chloride concentrations range from less than 10 milligrams per liter in the northwestern part of the county to more than 1,000 milligrams per liter in the southeast and extreme southwest. Total hardness concentrations range from 110 milligrams per liter in the northwest to 1,700 milligrams per liter in the southeast. In most of the county, high chloride and total hardness concentrations indicate the presence of saline water that entered the aquifer during the Pleistocene Epoch and has not been flushed out. Water quality in the aquifer has also been influenced by submarine discharge in the southeast and by heavy pumpage for irrigation in the southwest. High total hardness concentrations not accompanied by high chloride values in the western part of the county may be structurally controlled or may indicate the presence of gypsum evaporite beds in the upper 300 feet of the aquifer. (USGS)
W82-05829

HYDROGEOLOGIC SECTIONS THROUGH LEE COUNTY AND ADJACENT AREAS OF HENDRY AND COLLIER COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. H. Boggess, T. M. Missimer, and T. H. O'Donnell.
Geological Survey Open-File Report 81-638 (WRI), 1981. 1 Sheet, 6 Fig, 5 Ref.

Descriptors: *Groundwater, *Geohydrology, *Aquifers, *Water table, Aquifer characteristics, Geologic formations, Wells, Water yield, Water quality, *Florida, Lee County, Hendry County, Collier County.

The freshwater underlying Lee, western Hendry, and northern Collier Counties occurs within the marine terrace sands, the Fort Thompson, Caloosahatchee, Tamiami, and Hawthorn Formations. These are, respectively, the water-table aquifer, an aquifer in the Tamiami Formation, and an aquifer in the upper part of the Hawthorn Formation. These aquifers are separated by clay, marl, and marly limestone. Wells tapping the water-table aquifer are commonly less than 50 feet deep, with yields ranging from 5 to 500 gallons per minute. The water quality in the aquifer is usually good, except for iron, which generally exceeds 1 milligram per liter, and color, which ranges from 30 to 600 Platinum-Cobalt units. Wells tapping the Tamiami aquifer range in depth from about 60 to 300

feet; most are less than 100 feet deep. Yields range from 20 to 500 gallons per minute. The water quality in the Tamiami aquifer is good, except where affected by leakage from deep artesian wells. Wells tapping the upper Hawthorn aquifer range in depth from about 100 to 300 feet. Yields range from 10 to 500 gallons per minute. The water quality from the upper Hawthorn aquifer is good, except in areas where upward leakage from the deep artesian aquifer has occurred. (USGS)
W82-05830

HYDROLOGY OF AREA 3, EASTERN COAL PROVINCE, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb, L. C. Shaw, and D. E. Brown.
Geological Survey Open-File Report 81-537 (WRI), September 1981. 88 p, 65 Fig, 26 Tab, 29 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Acid mine drainage, Water pollution sources, Streams, Flow characteristics, Chemical analysis, Metals, Permits, *Pennsylvania, Eastern Coal Province, Ohio River basin.

Hydrologic data are presented for area 3 of the Eastern Coal Province, 4,077 square miles of the lower Allegheny River basin in western Pennsylvania. Seventy-three streams were sampled three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity, dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and botom material samples were analyzed for metals. Sixteen streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved sulfate indicative of acid-mine drainage. These streams were most common in the Redbank and Blacklick Creek basins and in the Conemaugh and lower Kiskiminetas River basins. Benthic invertebrates were not found in 11 of 64 streams sampled. An additional 13 streams had low benthic invertebrate diversity indices. Low diversity indices were most common in the southern part of area 3. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 3. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, National Water Data Storage and Retrieval System, and Office of Water Data Coordination are explained. (USGS)
W82-05831

HYDROLOGY OF AREA 25, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
E. E. Zuehls, G. L. Ryan, D. B. Peart, and K. K. Fitzgerald.
Geological Survey Open-File Report 81-636 (WRI), September 1981. 66 p.

Descriptors: *Hydrologic data, Water quality, *Groundwater, *Surface waters, *Coal mines, Geohydrology, Acid mine drainage, Water pollution sources, Strip mines, Soil classification, Agriculture, Chemical analysis, *Illinois, Interior Coal Province, Eastern region.

The eastern region of the Interior Coal Province has been divided into 11 hydrologic study areas. Area 25, located in west-central Illinois, includes the Spoon River and small tributaries to the Illinois River. Pennsylvanian age rocks underlie most of the study area. Illinois, with the largest reserves of bituminous coal, is second only to Montana in total coal reserves. Loess soils cover most of the study area. Agriculture is the dominant land use. Surface water provides 97% of all the water used. Precipitation averages 34 to 35 inches. Water-quality data has been collected at over 31 sites. Analysis for specific conductance, pH, alkalinity, iron, manganese, sulfate and many trace elements and other water-quality constituents have been completed. These data are available from computer storage through the National Water Data Storage and Retrieval System (WATSTORE). (USGS)
W82-05832

HYDROLOGY OF AREA 4, EASTERN COAL PROVINCE, PENNSYLVANIA, OHIO, AND WEST VIRGINIA,
Geological Survey, Columbus, OH. Water Resources Div.
D. K. Roth, and M. J. Engelke, Jr.
Geological Survey Open-File Report 81-343 (WRI), July, 1981. 62 p, 41 Ref, 3 Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Geohydrology, Acid mine drainage, Water pollution sources, Erosion, Sedimentation, Streams, Flow characteristics, *Ohio, *Pennsylvania, *West Virginia, Eastern Coal Province, Ohio River basin.

Area 4 (one of the 24 hydrologic areas defining the Eastern Coal Province) is located at the northern end of the Eastern Coal Province in eastern Ohio, northern West Virginia, and western Pennsylvania. It is part of the upper Ohio River basin, which includes the Beaver, Mahoning, and Shenango Rivers. The area is underlain by rocks of the Pottsville, Allegheny, Conemaugh, Monongahela Groups (or Formations) and Dunkard Group. Area 4 has a temperate climate with an annual average rainfall of 38 to 42 inches, most of its area is covered by forest. The soils have a high erosion potential where the vegetation cover is removed. In response to Public Law 95-87, 132 sites were added to the existing surface-water data-collection network in area 4. At these added sites, collected data includes discharge, water quality, sediment, and biology. The data are available from computer storage through the National Water Data Exchange (NAWDEX) or the published annual Water Resources Data reports for Ohio, Pennsylvania, and West Virginia. Hydrologic problems related to mining are: (1) Erosion and increased sedimentation, and (2) degradation of water quality. Erosion and sedimentation are associated chiefly with surface mining. Sediment yields increase drastically when vegetation is removed from the highly erosive soils. Degradation of water quality can be caused by acid-mine drainage from underground and surface mining. More than half the acid-mine drainage effluent in area 4 comes from underground mines. The rest seeps from abandoned surface mines. Usually in reclaimed surface mines the overburden is replaced in such a short time after the coal is taken out that oxidation of acid-forming minerals, commonly pyrite or marcasite, is not complete or is neutralized by the buffering action of calcareous minerals in the soils. (USGS)
W82-05833

HYDROLOGY OF AREA 5, EASTERN COAL PROVINCE, PENNSYLVANIA, MARYLAND, AND WEST VIRGINIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb, L. C. Shaw, and D. E. Brown.
Geological Survey Open-File Report 81-538 (WRI), September 1981. 92 p, 60 Fig, 22 Tab, 37 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Acid mine drainage, Water pollution sources, Streams, Flow characteristics, Chemical analysis, Metals, Permits, *Pennsylvania, *Maryland, *West Virginia, Eastern Coal Province, Ohio River basin.

Hydrologic data are presented for area 5 of the Eastern Coal Province, the 7,384 square-mile Monongahela River basin in western Pennsylvania, western Maryland, and north-central West Virginia. One hundred thirty-four streams were sampled about three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and bottom material samples were analyzed for metals. Eleven streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved-sulfate levels indicative of acid-mine drainage. These streams were most common in the Tygart Valley River basin, although indicators of acid-mine drainage were found throughout the Monongahela basin. No benthic invertebrates were found in 25 of 129 streams sampled. Such streams were most common in the Cheat and Tygart Valley River basins. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 5. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, WATSTORE, and indexes to water-data activities in coal provinces are presented. (USGS)
W82-05834

HYDROLOGY OF AREA 18, EASTERN COAL PROVINCE, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
V. J. May.
Geological Survey Open-File Report 81-492 (WRI), August 1981. 78 p, 30 Ref. 3 Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Streams, Acid mine drainage, Geohydrology, Chemical analysis, Permits, *Tennessee, Eastern Coal Province, Cumberland River basin.

The Eastern Coal Province is divided into 24 hydrologic reporting areas. This report describes the hydrology of area 18 which is located in the Cumberland River basin in central Tennessee near the southern end of the Province. Hydrologic information and sources are presented as text, tables, maps, and other illustrations designed to be useful to mine owners, operators, and consulting engineers in implementing permit applications that comply with the environmental requirements of the 'Surface Mining Control and Reclamation Act of 1977.' Area 18 encompasses parts of three physiographic regions; from east to west the Cumberland Plateau, Highland Rim, and Central Basin. The Plateau is underlain by sandstones and shales, with thin interbedded coal beds, of Pennsylvanian age. The Highland Rim and Central Basin are underlain by limestone and dolomite of Mississippian age. Field and laboratory analyses of chemical and physical water-quality parameters of streamflow samples show no widespread water quality problems. Some streams, however, in the heavily mined areas have concentrations of sulfate, iron, manganese, and sediment above natural levels, and pH values below natural levels. Mine seepage and direct mine drainage were not sampled. Ground water occurs in and moves through fractures in the sandstones and shales and solution openings in the limestones and dolomites. Depth to water is variable, ranging from about 5 to 70 feet below land-surface in the limestones and dolomites, and 15 to 40 feet in the coal-bearing rocks. The quality of ground water is generally good. Locally, in coal-bearing rocks, acidic water and high concentrations of manganese, chloride, and iron have been detected. (USGS)
W82-05835

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME I: ISLAND OF KAUAI,
Geological Survey, Honolulu, HI. Water Resources Div.
I. Matsuoka.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80025, Price: $75.25 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 81-1056, November 1981. 537 p, 2 Plates, 5 Ref.

Descriptors: *Data collections, *Surface water, *Water quality, *Streamflow, Flow characteristics, Flow duration, Discharge measurement, Gaging station, Sites, Sedimentation, Phytoplankton, *Hawaii, Kauai.

This report presents statistical summaries of surface-water discharge records and tabulations of surface-water-quality parameters at data-collection sites in Kauai, Hawaii. Data presented in this

report are mainly in tabular format. They consist of concise site description and information, flow-duration table, various monthly and annual discharges, lowest and highest mean discharges for each year for specified numbers of consecutive days, statistics for monthly and annual mean discharges, and tabulation and summary of surface-water-quality data. Water-quality parameters include sediment and phytoplankton data. Maps with surface-water data-collection sites, plotted with their respective hydrologic boundaries, are included. These data provide the information needed for deriving correlative associations and sound estimates that can be used in reaching surface-water management and control decisions. (USGS)
W82-05836

MAP SHOWING HOW THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF AUGUST 1980 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1977, IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $19.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-631, 1981. 1 Sheet.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Observations, Groundwater level, Coastal plains, *Maryland, Magothy aquifer, Cone of depression.

The map is based on the differences between two sets of water-level measurements made in 65 observation wells. One set was made in 1977, a relatively dry year, and the other set was made in 1980, another relatively dry year. The map shows that the potentiometric surface was higher in 1980, by as much as 9 feet, than it was in 1977, in a band a few miles wide near the outcrop and subcrop areas of the aquifer in northern Prince Georges County and central Anne Arundel County. In the remainder of the map area, the 1980 potentiometric surface was lower than it had been in 1977, with declines as great as 20 feet measured in well fields at Waldorf and Chalk Point. The network of observation wells was developed and is operated and maintained as part of the cooperative program between the U.S. Geological Survey and agencies of the Maryland Department of Natural Resources. (USGS)
W82-05838

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1981,
Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, and G. R. Schiner.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-101, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, Southwest Florida, Southwest Florida Water Management District.

A September 1981 potentiometric-surface map of the Southwest Florida Water Management District depicts the annual high water-level period. Water levels in most wells measured in September 1981 are equal to or higher than in May 1981. Levels averaged about 26 feet higher in the southern part of the area and 5 feet in the north. In the agricultural sections of southern Hillsborough, Hardee, southwestern Polk, northwestern De Soto, and Manatee Counties, water levels increased 10 to 46 feet. From September 1980 to September 1981, water levels ranged from a decrease of 11 feet in Citrus County to an increase of 9 feet in southern Hillsborough County. (USGS)
W82-05840

DISCHARGE DATA AT WATER-QUALITY MONITORING STATIONS IN ARKANSAS, 1980 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
R. K. Knott.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-157, 1981. 35 p, 3 Tab.

Descriptors: *Streamflow, *Flow rates, *Discharge measurement, *Water quality, Gaging stations, Data collections, Water pollution control, *Arkansas.

Discharge data were computed for a network of water-quality monitoring stations operated by the Arkansas Department of Pollution Control and Ecology. Some of the sites are located at U.S. Geological Survey of U.S. Army Corps of Engineers daily-discharge stations, but most sites are at points where discharges are not regularly measured. (USGS)
W82-05841

QUALITY OF WATER IN JAMES CREEK, MONROE COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05842

QUALITY OF WATER AND TIME OF TRAVEL IN GOODWATER AND OKATOMA CREEKS NEAR MAGEE, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05845

QUALITY OF WATER AND TIME OF TRAVEL IN LITTLE COPIAH CREEK NEAR CRYSTAL SPRINGS, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05847

HYDROLOGIC RECONNAISSANCE OF THE NOATAK RIVER BASIN, ALASKA, 1978,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-05848

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1981,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $3.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-118, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, East-central Florida, St. Johns River Water Management District.

This map presents the potentiometric surface of the Floridan acquifer in the St. Johns River Water Management District and vicinity for September 1981. The Floridan acquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area 20- and 40-foot intervals are used to show a deep cone of depression. The potentiometric surface ranged from 134 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 90 feet below NGVD in Nassau County. Record low water levels for September were recorded in many counties due to lack of rainfall. September 1981 levels were as much as 10 feet and commonly 2 to 3 feet lower than the below normal September 1980 levels. Water levels rose from September 1980 levels on the coastline at St. Augustine and from Flagler Beach south to New Smyrna Beach. (USGS)
W82-05849

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1981,
Geological Survey, Orlando, FL. Water Resources Div.
L. A. Bradner.
Available from the OFFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-259, 1982. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, Sumter County, Floridan aquifer.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for September 1981. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the high water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 85 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west-central area. (USGS)
W82-05850

MAP OF THE ANTELOPE VALLEY-EAST KERN WATER AGENCY AREA, CALIFORNIA, SHOWING GROUND-WATER SUBUNITS AND AREAS, AND DISSOLVED-SOLIDS CONCENTRATIONS, 1970-80,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
C. E. Lamb, and T. L. Hadley.
Geological Survey Open-File Map 81-698, 1981. 1 Sheet.

Descriptors: *Maps, *Groundwater, *Wells, *Dissolved solids, Water quality, *California, Groundwater subunits.

A map (scale 1:125,000) shows ground-water subunits and areas and graphs of dissolved-solids concentrations, 1970-80, in the Antelope Valley-East Kern Water Agency area, California. (USGS)
W82-05851

8. ENGINEERING WORKS

8A. Structures

RECONSTRUCTION OF THE NORTHERN DONETS-DONBAS CANAL,
G. P. Zhuk, and V. A. Osadchuk.
Hydrotechnical construction, No 8, p 765-772, August, 1980. 3 Fig, 3 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 5-9, August, 1980.

Descriptors: *Water conveyance, *Conveyance structures, Water transport, Canal construction, Construction methods, Expansion, *USSR, *Donbas Canal, Water demand.

One of the major factors determining the further development of industrial centers in the Soviet Union is the availability of adequate water supplies. In many cases, an effort is made to improve the water supply by increasing the capacity of the main pipelines without reconstructing the existing carrier canals. The Northern Donets-Donbas canal, which began operations in 1958, has undergone two major reconsructions without ever being shut down. The canal is the main source of drinking and industrial water supply for the majority of the industrial regions of the Donbas. The main

canal has a total length of 131.6 kilometers, of which 101.4 kilometers are open channel. Sag pipes, pressure pipes for pumping stations, and closed stretches of the canal comprise the remaining length. The first reconstruction of the canal, accomplished between 1966 and 1972, increased the discharge from the canal from 25 cubic meters per second to 32 cubic meters per second. The second reconstruction, carried out between 1973 and 1979, increased this discharge to 43 cubic meters per second. Activities conducted during each of the reconstructions are discussed. It is concluded that stagewise reconstruction of open canals can be accomplished under conditions of uninterrupted operation and that reconstruction of the structures and channel of existing canals provides an economical and expedient means of increasing water supplies. (Carroll-FRC)
W82-04773

THE SEARCH FOR RESERVOIR SITES IN AN URBAN ENVIRONMENT,
Thames Water Authority, London (England).
C. S. Sinnott, and M. H. Davies.
Journal of Hydrology, Vol 51, No 1-4, p 219-230, May, 1981. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Reservoir sites, *Urban areas, *Site selection, Reservoir siting, Cost analysis, Dams, Economic aspects, Environmental effects, London, *Great Britain, Storage reservoirs, Water supply.

Increases in the demand for water have traditionally led to the construction of larger and larger reservoirs, both increasing the environmental impact and necessitating the location of these reservoirs at greater distances from the center of demand. The alternative to the development of these large and remote storage reservoirs to meet the needs of urban areas is to set aside engineering and size considerations and identify sites which are primarily acceptable in terms of land use and environmental value. The Thames Water Authority, which is responsible for the catchments of the Thames and Lee rivers and for the London area in Great Britain, initiated a systematic survey to identify all possible reservoir sites within the area. Plans of each site were used to measure the dam length, maximum depth of the dam, and surface area for each dammed site and the surface area and perimeter of embankment for each impounded site. Estimates of the total costs of constructing the reservoir and the cost per unit volume of water stored were calculated for each site. The geological suitability of each site was evaluated to determine the potential need for lining. Each site was visited to check its suitability and to identify current usage and recent developments in the area. In order to quantify environmental effects, suitability grades were assigned on the basis of the amount of land affected, the quality of the land, the quality of the surrounding environment, and the remoteness from water. Finally, details of the suitability assessment, unit costs, and other data relating to each site were evaluated to classify the site as possible, doubtful, or unsuitable. A discounted cost analysis showed that the use of smaller sites meeting environmental constraints need not lead to financial penalties over the use of large sites. (Carroll-FRC)
W82-04867

THE RIVIERSONDEREND-BERG RIVER-JONKERSHOEK PROJECT MOST OUTSTANDING CIVIL ENGINEERING ACHIEVEMENT OF 1980.
Civil Engineering in South Africa, Vol 23, No 11, p 517, 519, 520, November, 1981. 6 Fig.

Descriptors: *Water supply development, *Dams, Civil engineering, *South Africa, Construction, Tunnels, Rivers.

The Riversonderend-Berg River-Jonkershoek Project was designed to collect surplus winter run-off of the upper reaches of the Berg, Dwars and Eerste Rivers and their tributaries, and divert all this water to the neighboring South Western Cape where conventional sources have fallen short of water demand, especially during the summer months. The Theewaterskloff Dam in the Riviersonderend was chosen for storage. The dam receives water directly from the Riviersonderend catchment and via the tunnel system from the Berg catchment. Theewaterskloof is a conventional earth dam with a 38 meter high dam wall and a 680 meter crest length. A spillway, capable of handling a probable maximum flood of 394 cubic meters/second, is of the side channel type and the chute ends in a stilling basin. The tunnel construction was the most challenging part of the project. The largest problem occurred when the Franschhoek tunnel penetrated through the granite at a point where a major fault coincided with the granite/sandstone contact. Environmental considerations played an important role in the planning and execution of the project. Much research was done to combat the potential problem of windblown sand conditions at the Theewaterskloff Dam. During winter months water will be diverted under force of gravity from the 1 million cubic meter capacity Klein Drakenstein Dam in the Elands River to Theewaterskloof via the proposed pipeline and the Dasbos and Granschhoek tunnels. In summer water from Theewaterskloof will flow back through the tunnel system and the pipeline as part of the supply to the Berg River area from Dasbos. (Baker-FRC)
W82-04886

BOTTOM-ENTRY LARGE-DIAMETER WELLS,
Food and Agricultural Organization of the United Nations, Rome (Italy). Land and Water Development Div.
R. G. Thomas.
Ground Water, Vol 20, No 1, p 96-98, 1982. 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Deep wells, *Open wells, *Partially penetrating wells, *Cost analysis, *Well hydraulics, Wells, Screened wells, Well screens, Screens, Laminar flow, Mathematical equations, Water storage, Drawdown, Aquifer characteristics.

In areas where there are highly permeable gravel aquifers of relatively shallow depth, the bottom entry large-diameter well should be considered as an alternative to drilled and screened wells. In constructing a large-diameter well, a concrete or other casing is sunk as digging proceeds. When the water table is reached, a grab bucket device is usually needed for dewatering to continue digging. In low permeable rocks, large-diameter wells provide storage of water. For a 75% penetrating well, discharge increases roughly by 70% for each doubling of the radius. Drawdown outside the casing is not very great, making these wells a poor choice for drainage purposes. Nonlaminar flow conditions were examined using the Forchheimer equation. To prevent sand filling, a natural gravel pack is allowed to form, or backfilling with coarser clean gravel is employed. The capital costs for large-diameter well operation will depend on the well location. The large diameter, bottom entry well can use a centrifugal pump rather than a turbine pump which is also a savings in energy costs. (Geiger-FRC)
W82-04919

CAVITY WELL,
Food and Agricultural Organization of the United Nations, Rome (Italy). Land and Water Development Div.
R. G. Thomas.
Ground Water, Vol 20, No 1, p 94-95, 1982. 1 Tab, 5 Ref.

Descriptors: *Well hydraulics, *Irrigation wells, *Well casing, *Fully penetrating wells, *Pump wells, Wells, Groundwater mining, Alluvial plains, Test wells, Well yield, Deep wells, Drawdown, Economic aspects.

Cavity wells have been used in India's Gangetic alluvial plain for the past 15 years. The alluvium sand stringers are often overlain with fine silt clays with reasonably developed soil profiles, root casts, and Kankars (calcium carbonate rock fragments). The cavity well is constructed with a tripod and bailer bit. When the water table is reached, blank casing is installed and drilling continues. The blank casing is then pulled back about 0.5 m into the clay layer and a centrifugal test pump is installed. The well is pumped at a low rate until the sand no longer comes out. The pumping rate is then increased in small stages until the discharge is somewhat greater than what the farmer will need. Such wells usually last at least 5 years and may be replaced with relative ease. In a comparative test, a fully penetrating well gave a discharge of 41.4 cu m/h while the cavity well discharged only 36.7 cu m/h. The cavity well seems to be economically feasible for this section of India. More research is needed into the conditions of stability for the construction of deeper wells. (Geiger-FRC)
W82-04920

THE OVERTOPPING OF THE PALAGNEDRA DAM,
Ecole Polytechnique Federale de Lausagne (Switzerland).
J. Bruschin, S. Bauer, P. Delley, and G. Trucco.
International Water Power and Dam Construction, Vol 34, No 1, p 13-19, January, 1982. 7 Fig, 3 Tab, 3 Ref.

Descriptors: *Flood damage, *Reservoirs, *Dams, *Palagnedra Dam, Rainfall, Precipitation, Floods, Bypass channels, Spillways, Design criteria, Overflow channels, Construction, *Switzerland.

During the floods of August, 1978, severe damage was sustained by the Palagnedra reservoir and other installations of the Verbano hydroelectric scheme in Ticino, Switzerland. Early on in the event the diversion tunnel was progressively opened. Later between 4 and 6 p.m. it was gradually closed, in response to a request by the police, in the hope of delaying the flooding of a camp ground about 10 km downstream from the dam. The flood had the following consequences: overtopping of the dam occurred along its full length, resulting in an erosion breech 30 meters deep and 25 meters wide in the morainic material supporting the diaphragm: about 25,000 cubic meters of wooden debris and logs of all dimensions from forests in the upper parts of the catchment found their way into the reservoir; about 1,800,000 cubic meters of sand and gravel from various centers of erosion entered the reservoir; the part of the reservoir upstream of the intermediate dam was completely filled up, so that the sill at the inlet of the diversion tunnel was covered by sand and logs 12 to 14 meters deep; the gauging station of the Melezza, near Camedo just upstream of the reservoir was destroyed at 7 pm; and the grating of the water intake was partly destroyed, blocking the bypass tunnel. The storm itself was exceptional both in its large area of high precipitation and in an unusual general meteorological situation. A physical model was constructed to better understand the behavior of the mass of wood carried by the bore in the canyon and to the spillway. Remedial work and efforts to improve forecasting are underway. The major lesson learned concerns the design of the spillway. (Baker-FRC)
W82-04952

APPLICATION OF A TWO-DIMENSIONAL MODEL OF FORMATION OF STORM RUNOFF TO CALCULATION OF THE RAIN-WATER COLLECTOR-DRAIN DISCHARGE FROM AN URBANIZED TERRITORY,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2A.
W82-05027

ESTIMATES OF RESILIENCE INDICES BY SIMULATION,
Harvard Univ., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W82-05046

ESTIMATING RESILIENCE BY CANONICAL ANALYSIS,
Harvard Univ., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W82-05047

RELIABILITY, RESILIENCY, AND VULNERABILITY CRITERIA FOR WATER RESOURCE SYSTEM PERFORMANCE EVALUATION,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 6A.
W82-05078

HYDRAULIC CALCULATIONS OF STABLE UNLINED CANALS BY THE VERTICAL VELOCITY DISTRIBUTION METHOD,
G. P. Skrebkov.
Hydrotechnical Construction, Vol 15, No 6, p 346-350, June, 1981. 3 fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 25-28, June, 1981.

Descriptors: *Canal design, *Flow velocity, *Channel erosion, Channel morphology, *Design criteria, Velocity distribution, Hydraulic design, Erosion, Stable channels, *Sediment transport, Soil mechanics, Siberia.

The permissible velocity method of designing unlined canals, unsuitable for very large canals used for runoff diversion of northern and Siberian rivers, was modified by considering the hydraulic stability of the channel on any stretch. The mean velocity of flow was replaced with the averaged velocity on a vertical. The permissible velocity of the flow was replaced with the permissible velocity of the same vertical. This allowed evaluation of the stability of channels composed of different soils and the selection of a hydraulically stable cross section. The permissible velocity distribution was plotted using equations for the permissible velocity for noncohesive soil on a horizontal bed with Lane's correction to account for the decrease in stability of the soil particles on the slope. A sample problem, calculation of a hydraulically stable canal for discharging 1000 cu m per sec in sand, illustrated the method. An approximate depth of 16-18 m and a parabolic shape was first estimated. Testing a 17 m depth in the equations showed that the cross section obtained would produce and erodible channel. Consideration of the sand dune formation produced a final channel of 6.5 m deep, 170 m surface width, 3700 sq m cross sectional area, mean velocity 0.27 m per sec, and velocity on the channel axis, 0.286 m per sec. This approached the shape of a natural river channel. (Cassar-FRC)
W82-05108

CONTROLLING THE QUALITY OF COMPACTION OF EARTH FILL IN THE CONSTRUCTION OF HIGH DAMS,
S. V. Bortkevich, V. I. Vutsel', A. G. Chernilov, and N. F. Roiko.
Hydrotechnical construction, Vol 15, No 5, p 263-269, May, 1981. 4 Fig, 2 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 9-12, May, 1981.

Descriptors: *Compaction, *Quality control, *Dam construction, Soil mechanics, Earth dams, Soil compaction, Soil physical properties, Nurek Dam, Density, Sampling, Soil density.

A method for quality control of compaction during earth dam construction was developed and tested during building of the Nurek Dam. Quality of compaction depended on elative density. Monolith samples weighing 3-5 kg were removed from the compacted area. Samples of fines from the same area were collected simultaneously. After weighing to ensure that samples contained no cracks, the content of the fines in the monolith and the monolith dry density were determined. the placement density of the fines and of the soil as a whole were determined by equations. This method required samples of 2-3 liters compared with up to 1000 liters for the pit sampling method. Maximum error was + or - 20 kg per cu m. (Cassar-FRC)
W82-05109

SHAFT SPILLWAYS COMBINED WITH A WATER INTAKE,
A. N. Aliferov.
Hydrotechnical Construction, Vol 15, No 5, p 311-314, May, 1981. 3 fig, 6 ef. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 53-55, May, 1981.

Descriptors: *Spillways, *Intakes, *Dam design, Hydraulic structures, Rivers, Hydroelectric plants.

A combination spillway and intake was designed to reduce costs and save space at hydrostations on mountain rivers. These structures discharge flood water, take in water from the reservoir, divert water temporarily, and empty the reservoir to flush sediment. A typical project has a horizontal tunnel, intake tower, inclined shaft, and a connecting structure. The spillway shaft is inclined at an angle of 60 degrees to the tunnel, providing a free-flow hydraulic regime over the length of the spillway passage. Extensive aeration is produced. A ski jump bucket is used to connect the flow from spillway to river. Large, strong rocks are placed at the point of impact to prevent scouring of the river bed. (Cassar-FRC)
W82-05111

STRESS-STRAIN STATE OF AN ARCH DAM BASED ON DATA OF LONG-TERM ON-SITE OBSERVATIONS,
I. F. Blinov, E. M. Mirzak, and Y. P. Shaikan.
Hydrotechnical Construction, Vol 15, No 6, p 360-365, June, 1981. 3 Fig, 3 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 34-38, June, 1981.

Descriptors: *Stress analysis, *Dam stability, *Concrete testing, Strain measurements, Hydroelectric plants, Temperature effects, Design criteria, *Arch dams, Safety, Dam foundations, Reservoirs.

Stress-strain monitoring equipment consisting of 885 transducers and meters was installed in a double arch dam 70 m high and 285 m long to study deformations and temperature changes during filling, October 1971 to 1980. Temperatures were governed by seasonal temperatures, structural features, and orientation toward the sun. The temperature difference between the surfce layer of the rock foundations and the concrete stabilized at 4 C in October 1971 when the water level reached 22 m. Deformations of intersectionsl joints in the dam were described. Most separations were less than 0.2 mm. After regrouting several joints which had opened to 2.1-4.3 mm, no further openings were observed in these sections. There was some disturbance of the joint between the concrete and the foundation during construction. After the reservoir was filled to 52 m, the maximum opening decreased to 0.05-0.5 mm. Vertical and horizontal movements by the dam varied within + or - 2.0 mm. Stresses observed were within those assumed in design. (Cassar-FRC)
W82-05112

DESIGN OF THE COMPOSITION OF TRANSITION LAYERS OF ASPHALTIC CONCRETE MEMBRANES IN EARTH DAMS,
Y. N. Kasatkin.
Hydrotechnical Construction, Vol 15, No 6, p 357-360, June, 1981. 3 Fig, 1 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, 32-34, June, 1981.

Descriptors: *Asphalt concrete, *Dam design, *Soil porosity, Concretes, *Earth dams, Soil mechanics, Pores, Transition zone, Rocks, Soil compaction, Compaction.

Equations were developed to describe the penetration of asphaltic concrete into soil pores. This is important in design of earth dams containing asphaltic concrete membranes. Use of the equations was illustrated in a sample problem in which available rock at a construction site was evaluated for suitability as a component of the transition layer of a membrane being made of plastic coarse-grained asphaltic concrete. (Cassar-FRC)
W82-05113

DAMMING OF THE KARA-BOGAZ-GOL STRAIT WITHOUT SIDE DIVERSION OF THE FLOW,
P. K. Osokin, D. L. Melamut, N. K. Golubev, and F. G. Zagirov.
Hydrotechnical Construction, Vol 15, No 6, p 324-328, June, 1981. 6 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 11-14, June, 1981.

Descriptors: *Dam construction, *Hydraulic fill, Cofferdams, Water level, *Kara-Bogaz-Gol Gulf, *Caspian Sea, Engineering.

Damming of the 200-250 m wide, 7 km long strait between the Caspian Sea and the Kara-Bogaz-Gol gulf was accomplished without side diversion of the flow. There was a 2 m high waterfall in an erodible rock channel between the two water bodies, which had the potential for a breakthrough of water from the sea into the gulf, a natural evaporator. Although the hydrological conditions during the scheduled construction period, fall-winter 1979-1980, were more severe than were considered in planning, the project proceeded. The gap was narrowed by hydraulic filling with sand to the point where the flow eroded the added material. At this stage of 70 m opening remained. Local stone and cement-sand cubes were used to fill the space until a 23 m wide gap remained. The final stage of closure was the most strenuous. This was accomplished by first protecting the left bank and end of the cofferdam with old steel frameworks filled with scrap stone matrial. Sand-cement cubes, cabled together, were pushed into the gap and empty space filled with stone. An underwater still 40 m downstream helped to decreased the difference in water levels between the gulf and the sea to 1.21 m drom the original 2.03 m. (Cassar-FRC)
W82-05114

USE OF WATERTIGHT FILM FACINGS FOR REPAIR WORKS ON THE GREAT STAVROPOL CANAL,
For primary bibliographic entry see Field 8G.
W82-05117

APPLICATION OF AND GUIDELINES FOR USING AVAILABLE DAM BREAK MODELS,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
B. A. Tschantz, and R. M. Mojib.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224577, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 83, May 1981. 84 p, 21 Fig, 7 Tab, 62 Ref, 3 Append. OWRT A-059-TENN(1), 14-34-0001-0145.

Descriptors: *Dam safety, *Dam failure; *Floods, Channel flow, Model studies, St. Venant Equations, Routing, NWS DAMBRK Model, HEC-1 Dam Safety Version Model, SCS simplified dam break procedure, Dams, Dam stability, *Dam design, Design criteria, *Comparison studies.

Potential dam break model users are guided in selection and application of available models. A high-hazard category test dam example provided a means for comparing and evaluating different approaches to dam break analysis. A review of dam failure model literature showed that few computerized models were ready for immediate general application. The National Weather Service (NWS) DAMBRK Model, the HEC-1 Dam Safety Version Model, and the Soil Conservation Service (SCS) Simplified Dam Break Procedure were chosen for testing and evaluation. Additionally, Keulegan's classic instantaneous dam-break equations were used to estimate and compare instantaneous peak flow at the failed test dam. These four approaches were applied to a 36-foot-high homogeneous earthen embankment for a design PMF inflow hydrograph. The downstream test reach extended one-half mile below the test dam. The computerized NWS and HEC-1 models are capable of handling a variety of complex dam breach problems. The hand-worked SCS and Classic methods provided a quick analysis of simple types of dam break problems. A self-explanatory comparative evaluation of the capabilities and costs of

different dam break models is presented to guide model users in choosing the appropriate models for specific dam break situations and for given resources.
W82-05152

SAFETY ANALYSIS OF HIGH HAZARD DETERIORATING CONCRETE GRAVITY DAM-RESERVOIR SYSTEMS INCLUDING CORRECTIVE MEASURE - EARTHQUAKE AND DYNAMIC STUDY,
Delaware Univ., Newark. Dept. of Civil Engineering.
C. Y. Yang, V. Chiarito, and P. Dressel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224718, Price codes: A06 in paper copy, A01 in microfiche. Report, October 1981. 9 p, 35 Fig, 9 Tab, 43 Ref, 4 Append. OWRT A-047-DEL(4), 14-34-0001-1108.

Descriptors: *Concrete dams, *Safety, *Earthquake engineering, *Probabilistic process, *Gravity dams, *Reservoir design, *Dynamic programming, Dams, Construction, Earthquakes, Engineering, Assessments, Mathematical studies, Reservoir construction, Dam construction, Systems analysis, Durability, Hazards, Dam design, Design criteria.

Research was carried out to analyze the safety of high-hazard deteriorating concrete gravity dam-reservoir systems against earthquakes, using the Delaware Hoopes Dam as a model. Due to the uncertainty in earthquake occurance and magnitude, a probabilistic approach to the dam-reservoir-earthquake problem was sought. Design and analysis based on probability concepts were worked out in detail for the Hoopes Dam. The result of this study revealed a lower design earthquake than that currently used by engineers. In addition, the effectiveness of the post tension strengthening techniques currently used by engineers was studied using a crude dynamic analysis, with the finding that the strengthening technique is highly effective in resisting earthquake shocks, provided that the cable system is correctly designed and constructed. (Zielinski-MAXIMA)
W82-05296

PRESSURE DISTRIBUTION DESIGN FOR SEPTIC TANK SYSTEMS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W82-05439

FROGMEN'S SUBTERRANEAN SWIM SITES SOURCE,
World Water, Vol 5, No 2, p 17-18, February, 1982. 4 Fig.

Descriptors: *Exploration, *Excavation, *Water resources development, Water demand, Water supply, Drinking water, Groundwater Aquifers, Financial aspects, Constsruction, France, Karst.

In May of 1973 divers entered the 35 m-diameter pond of Le Lez and penetrated 520 meters upstream to find the top of a seemingly bottomless pit. Based on their efforts, engineers constructed a new subterranean intake structure which will yield some 2 cubic meters/second for future use in the city of Montpellier, France and the surrounding areas. A pumping station was built 30 meters below the surface and immediately above this 'bottomless pit'. A 230 meter long, 1.8 meter diameter tunnel was cut, using liquid oxygen to freeze the ground. The tunnel will carry water from the underground pumphouse to the intake of the aqueduct of Le Lez spring. The underground pumphouse was also excavated using the liquid oxygen method, with a concrete lining poured behind shuttering for the vaulted roof in advance of excavating the main chamber. Three pumps will lift water through shafts to the newly driven supply tunnel. The construction project is now halfway to completion. Water consumption in the city of Montpellier has doubled over the past 20 years, making some basic improvement in supply a matter of urgent necessity. The groundwater has excellent quality and will be cheaper to use than surface water, which would need significant treatment. (Baker-FRC)
W82-05501

SELECTING THE OPTIMUM CROSS-SECTION OF A CONCRETE GRAVITY DAM,
Ministry of Energy, Sofia (Bulgaria).
S. Iliev, and L. Kalchev.
International Water Power and Dam Construction, Vol 33, No 12, p 23-27, December, 1981. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Gravity dams, *Dam design, *Concrete dams, Dam construction, Computer programs, Design criteria, Mathematical equations.

The natural terrain, concrete qualities, and underground outline of a concrete gravity dam are characterized by a number of factors which directly affect the choice of its cross-section. A computer program has been developed which used 11 inputs to formulate an optimum cross-section of a dam which can then be subjected to comprehensive static investigations. The inputs include the design factor of friction between concrete and rock at the baseline, the design stress of adhesion between concrete and rock at the baseline, characteristics of the construction soil, density of the concrete, density of the water, the design factor of safety against sliding, the uplift factor at the upstream side, the uplift factor at the drainage curtain, the uplift factor at the downstream side, the ratio between the distance from the upstream edge of the line of intersection of the baseline with the drainage curtain and the length of the baseline, the design ratio between the vertical and main stress, and the dam height at the downstream edge of the baseline. The main objective of this method is to provide a rapid and adequate guide to an optimum solution and, by selected combinations of the factors influencing a dam's cross-section, to permit the best assessment of their importance. The program provides a number of solutions from which the engineer may choose the most appropriate. Additional sets of solutions can be obtained by altering the inputs. In addition, this proposed method of deriving a generalized criterion for choosing a cross-section can include factors such as compression caused by sediments or seismic forces without changing the structure of the equation expressing the generalized criterion. (Carroll-FRC)
W82-05510

SAFETY OF DAMS JUDGED FROM FAILURES,
COBA International Consultants, Lisbon (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 33, No 12, p 32-35, December, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Dam failure, *History, Dams, Safety, Dam construction, Dam stability, Prediction, Mathematical studies, Disasters, Probabilistic process, Statistical studies.

Recent statistical studies based on the historical records of disasters and incidents associated with large dams have led to the development of failure probability predictions applied to dams of any kind built. It is suggested that such an assessment is misleading and erroneous, since the percentage of failures is currently falling and careful design, construction, and instrumentation is likely to reduce the failure rate even further. Review of the available data on failures of dams more than 15 meters high since 1796 which haae been registered at Electricite de France through 1979 shows that there are many qualifying conditions. Without considerration of such qualifying characteristics as height, type of dam and construction standards, age, number of inspections, maintenance conditions, and instrument monitoring, simple statistical numbers of disasters per year are meaningless. Review of the failures of 136 dams throughout the world showed that the large majority (90) occurred in dams between 15 and 30 meters high and that 80 of the failures involved earth dams. Dams in remote areas are more prone to failure. In addition, dams are much more vulnerable during and immediately after construction than after they become operative. The most frequent failures occur during the first complete filling of the reservoir. It is suggested that perhaps 70% of all dam failures could be prevented if first fillings of new dams were carefully controlled, supervised, and monitored with instruments and if all old dams were the object of careful inspection and calculation. (Carroll-FRC)
W82-05512

COMPARISON OF ISOSTATIC AND HYPERSTATIC PENSTOCKS AT SANTA ISABEL, BOLIVIA,
Montreal Engineering Co. Ltd. (Quebec).
J. L. Gordon, W. Bolliger, and J. S. Cary.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 1-12, 1982. 12 Fig, 7 Tab, 4 Ref.

Descriptors: *Penstocks, *Design criteria, Construction, Dams, Water resources development, Planning, Santa Isabel, Boliva.

In 1973 work was completed on the construction of the Santa Isabel hydroproject in central Bolivia. The project includes a penstock, with the lower half comprising an unusual hyperstatic design with no expansion joints and anchors at alternate bends. The penstock was designed for a static head of 864 meters plus 15% waterhammer. It burst when filled with water on March 16, 1973 at a head of 735 meters. An improper weld at an unsupported bend in the hyperstatic section of the penstock was blaimed for this failure. In March 1981 consturction of a second parallel penstock was completed. Use was made of an isostatic upper half and hyperstatic lower half penstock at Santa Isabel; this was justified on the grounds of having to parallel an existing penstock of similar design. It became evident after work had been completed that an all-isostatic design would have been very close in cost to the combined isostatic-hyperstatic design. There was very little difference in the weight of steel between an isostatic penstock having expansion joints between anchors and a hyperstatic penstock where every alternate anchor is eliminated and the free bend allowed to move with thermal expansion and contraction. There is a substantial reduction in anchor block concrete in a hyperstatic penstock, compared with an isostatic penstock. There is also a substantial increase in pier concrete in a hyperstatic penstock compared with an isostatic one. Finally, there was very little net difference in total anchor and pier concrete between the two types of penstock. Notwithstanding this financial consideration, it was necessary at Santa Isabel to use the hyperstatic penstock design to avoid an unstable area. It is recommended that hyperstatic penstocks be used only when the geological or topographical conditions do not favor use of an isostatic design penstock. (Baker-FRC)
W82-05561

UPLIFT PRESSURE OF WATER ON THE BASE OF HYDRAULIC STRUCTURES IN LIMIT DESIGN STATES (DISCUSSION OF CONSTRUCTION SPECIFICATIONS),
R. N. Petrashen.
Hydrotechnical Construction, Vol 15, No 7, p 427-431, 1981. 1 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 33-35, July, 1981.

Descriptors: *Water pressure, *Dam foundations, Rock mechanics, Hydraulic structure, Uplift pressure, Pressure distribution, Dam design, Design criteria, Limiting factors, Dam failure, Seepage.

The equation for calculating total uplift pressure of water on the base of a structure may be expressed as $Q = a2qF$, where F = the total area of the base of the structure, f = the area of the close contacts where seepage water cannot penetrate, and $a2$ = a coefficient equal to $(1 - f/F)$. Current design practices call for calculations with respect to limit states (the condition existing just before failure). However, previous theoretical and experimental investigations of uplift did not indicate the state under investigation, nor did they account for changes in density and loads in fracture or shear zones. The coefficient a2 has been arbitrarily as-

signed values from 0.5 to 1. Calculations how that the coefficient a2 should be assumed equal to 1 in the limit state and in elastic states in the operating stages for all materials with relatively large values of water permeability and sufficiently long action of the head. It is possible that a2 can have a value of less than unity in the elastic state for massive rigid materials under moderate stresses. The exact values must be obtained experimentally. (Cassar-FRC)
W82-05582

SELECTION OF TEMPORARY DIVERSION TUNNELS AND TUNNEL SCHEMES FOR DISCHARGE OF WATER,
E. I. Karabaev.
Hydrotechnical Construction, Vol 15, No 8, p 476-488, 1981. 5 Fig, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 30-38, August, 1981.

Descriptors: *Diversion structures, *Tunnels, *Hydroelectric plants, Construction, Rivers, Dam construction, Flow regulation, Hydraulic structures, Optimization, Design criteria.

Diversion tunnels in 38 Soviet and 105 foreign hydrostations are statistically analyzed. All temporary and combined tunnels can be classified into four groups: uncombined diversion tunnel spillways, combined diversion-service tunnel spillways, diversion-service tunnel structures combining functions with the turbine tunnels, and diversion-service tunnel structures partially combined with the headrace and tailrace tunnels. Types of diversion tunnels used are principally determined by the following parameters: width and shape of river canyons at the hydrostation site, character of the runoff hydrograph and design discharges, type and height of the dam, location and type of the power station, presence of permanent service tunnel structures as part of the hydrostation, and construction characteristics. A list of 5 basic principles for selecting tunnel schemes and parameters of diversion tunnels for specific cases is presented. To minimize cost the following basic principles apply: stage-by-stage examination of water diversion at the site, determination of the permanent set of components of the cost and structures of the system providing diversion at each state under the specific conditions of the hydrostation, calculation of the cost related to diversion under the given conditions of the investigated stage, and performance of the comparative technicoeconomic calculations of the diversion system for each alternative of tunnel parameters. (Cassar-FRC)
W82-05588

PROSPECTIVE ENGINEERING DESIGNS FOR UNDERGROUND HYDRAULIC STRUCTURES,
V. F. Ilyushin.
Hydrotechnical Construction, Vol 15, No 8, p 439-447, 1981. 8 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 9-14, August, 1981.

Descriptors: *Hydraulic structures, *Tunnel construction, *Underground structures, Spillways, Water conveyance, Intakes, Tunnel lining, Conduits, Grouting, Design criteria.

New engineering designs developed and used in construction of underground structures of the high-head Central Asian hydrostations are described. These stations operate under conditions of high water pressures and high flow velocities. Intake designs include automatic flow proportioning between different sections of a submerged intake to handle trash clogging, a surface intake-spillway, and a multilevel inlet adjustable to different degrees of siltation. The underground spillway transition section of the Papan Reservoir splits the flow to preclude overpressurization of the outlet tunnel, reduce hydrodynamic loads on the bottom and walls of the transition chamber. The Nurek hydrostation transition section of the service spillway contains a quick-knockdown concrete plug for switching channels. For pressure conduits, corrugated steel linings equipped with circular stiffeners with blind notches opposite the corrugations are proposed to improve the contact with surrounding rock. Steel interblock closures in tunnel spillways are being replaced with polymer concrete or other wear and cavitation resistant material. Drainage to protect tunnel linings can be accomplished by leaving a small layer of ungrouted rock between the tunnel lining and the grouted layer. Water entering this permeable layer is discharged through a drainage system. (Cassar-FRC)
W82-05589

THE EXPANSION OF TWO BOLIVIAN PLANTS,
Empresa Nacional de Electricidad, Cochabamba (Bolivia).
M. Zenteno, A. W. Williams, and J. L. Gordon.
International Water Power and Dam Construction, Vol 34, No 2, p 26-28, 29-31, February, 1982. 5 Fig, 3 Ref.

Descriptors: *Powerplants, *Construction, Construction materials, Design criteria, Dams, Reservoirs, Bolivia.

The central Bolivian electric system had two powerplants with a total installed capacity of 180 MW, the Corani and Santa Isabel hydroplants, regulated by the Corani storage reservoir. Construction of the first phase of the Corani development was completed in 1967 with the commissioning of two 15 MVA units. Flood relief is provided by a masonry weir spillway. The 659 meter long penstock, of conventional design, has expansion joints between the anchor blocks. The penstock varies in diameter from 1 meter at the upper end down to 0.9 meters at the lower end, where it bifurcates to the two units. The Corani powerhouse comprises a concrete slab with footings for a concrete column and beam superstructure and a steel truss supporting an aluminum roof, all founded on a dense clay soil containing large boulders. A re-regulating reservoir having a nominal storage of 100,000 cubic meters has been built between Corani tailrace and the Santa Isabel intake. The reservoir will be used to even out the usage and demand for water between the two powerplants and to store flash-flood flows from the Vinto river intakes. During construction of the Santa Isabel tunnel, an access adit was built from the Vinto river valley, which is now used as a water passage to direct the diverted water from the east and west branches of the Vinto river into the Santa Isabel tunnel. The Santa Isabel penstock with a length of just under 2.8 km constituted a major portion of the work required to expand the development. (Baker-FRC)
W82-05598

THE AGUS II SCHEME IN THE PHILIPPINES,
National Power Corp., Manila (Philippines).
S. J. de Jesus, and R. P. Clark.
International Water Power and Dam Construction, Vol 34, No 2, p 17-23, February, 1982. 8 Fig.

Descriptors: *Dams, *Construction, Environmental effects, Philippines, Agus River, Hydroelectric plants, Powerplants, Mindanao.

Lake Lanao has a surface area of 350 square kilometers and a total drainage area of 1680 km. The Agus river is the single outlet of the lake. A cascade of seven dams has been planned, with Lake Lanao serving as a natural regulating pond. The optimized operation of Lake Lanao based on maximized total energy output in the Agus project chain resulted in a capacity of 944 MW. The site of Agus II is 6 km downstream of Lake Lanao, with elevations ranging from 650 at the dam to 420 at the tailrace channel. The terrain varies from gently rolling to steep. The deeply weathered lava flows render the foundation unsuitable for a concrete dam, so that only an earth dam was feasible. The dam constructed is a homogeneous earth dam with a sloping filter drain leading into a downstream horizontal blanket. The spillway consists of two bays with bottom radial gates 11 m wide and 7.5 m high. The contract for the construction of the powerplant was awarded in December of 1974. Right-of-way problems prevented the immediate acquisition of the land for the dam and the main structures. Excavation of the powerhouse began in June 1975. Excavation of the spillway, intake structure and approach canal started in January 1976. Impounding of the reservoir began in April 1979, in stages as permitted by the advancement of the approach canal lining. (Baker-FRC)
W82-05599

AERATION AT HIGH VELOCITY FLOWS,
Parana Univ., Curitiba (Brazil).
N. L. de S. Pinto, S. H. Neidert, and J. J. Ota.
International Water Power and Dam Construction, Vol 34, No 2, p 34-38, February, 1982. 12 Fig.

Descriptors: *Entrainment, *Spillways, Design criteria, Model studies, High flow, Flow velocity, Cavitation, Aeration, Brazil, Dams, Foz do Areia Dam, Construction.

This article deals essentially with the phenomenon of air entrainment during high velocity flows down spillway chutes. Based on a general analysis of the air entrainment mechanism and of data from prototype and laboratory tests, an analytical treatment of the problem is developed, setting a basis for predicting the performance of aeration devices from hydraulic model studies. An aeration system during the design stage should be considered in the following light: at what velocity should first aeration be provided, what is the volume of air entrained at the aeration, and what is the spacing between aerators to maintain a given protection level. Tests were performed at the Foz do Areia spillway, on the Iguacu river in Brazil. During the initial phase of spillway operation, measurements of air flow entrained at each aerator for different water discharges from 500 to 3300 cubic meters/second were made. The water discharges were determined from spillway rating curves obtained in a 1:100 cale hydraulic model. Air discharges were calculated from pressures measured at the walls of the aeration towers, used as Venturi meters. Pressure distribution was also measured under the jet along the step wall of the aerator. (Baker-FRC)
W82-05602

CABLEGATION: I. CABLE CONTROLLED PLUGS IN PERFORATED SUPPLY PIPES FOR AUTOMATIC FURROW IRRIGATION,
Science and Education Administration, Kimberly, ID.
W. D. Kemper, W. H. Heinemann, D. C. Kincaid, and R. V. Worstell.
Transactions of the ASAE, Vol 24, No 6, p 1526-1532, 1981. 12 Fig, 1 Tab, 4 Ref.

Descriptors: *Irrigation engineering, *Plug flow, Pipe flow, Pipes, Cablegation, Design criteria.

To encourage farmers to reconsider surface irrigation, systems are needed that will provide uniformity of water distribution, have low initial and maintenance costs, minimize labor input, and do not hinder field operations. Such a system is described. A single pipe line serves both the transmission and distribution functions at the head of a furrowirrigated field. Pipe size was selected to be slightly less than full when carrying the flow rate available on the existing grade. Orifices were drilled in the pipe at 30 degrees from vertical toward the furrow side. Water was forced out of these orifices by a plug in the line. Position and movement of the plug were controlled by attaching it, with a cable through the pipe, to a reel at the inlet end with its rotation rate governed by a geared down, 12 v DC electric motor, regulated in turn by a rheostat. A computer model predicted and field tests corroborated that orifices near the plug had highest flow rates, with flow diminishing in orifices further upstream to zero flow at a distance determined by total flow, orifice, moving downstream at speeds from 3 to 6 miles per hour, flow begins at the maximum rate and then decreases with time until the flow ceases. Effects on flow times and rates from orifices of varying orifice size, total water supply rate and plug speed, and of using multiple plugs and sleeving, are illustrated. Assuming runs that are 300 meters long so the sytem serves 12 ha, thee installation costs would be about $298/ha ($121/acre). If the pipe is left above ground, the life of the sytem is about 10 years. (Baker-FRC)
W82-05617

GENERATING POWER FROM COMPENSATING FLOW.
For primary bibliographic entry see Field 8C.
W82-05624

ISSUES IN SIMULATION MODEL DESIGN--A CASE STUDY,
Waterloo Univ., (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05627

ECONOMIC ANALYSIS OF WATER MAIN BREAKS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, and A. Pelliccia.
Journal of the American Water Works Association, Vol 74, No 3, p 140-147, March, 1982. 8 Tab, 21 Ref.

Descriptors: *Economic analysis, *Pipes, *Rehabilitation, Water distribution, Water mains, Prediction, Aging, Binghamton, New York.

A simple quantitative method for determining which pipes in a water distribution system should be replaced is based on a history of recorded breaks. This study was initiated by the city of Binghamton, New York, whose 100-year old pipe system needed upgrading. Equations are presented for two approaches: replacing groups of pipes as a unit or on a pipe-by-pipe basis. A set of equations is given to predict the rate of pipe breaks depending on diameter, age, materials, temperature, and previous break history. An economic analysis estimates the cost of repairing a break, including the damage and inconvenience, and whether pipes need immediate or postponed repairs. Factors to consider in pipe replacement are: the cost of a break, price replacement pipe, total length of pipe, length of pipe to be replaced, pipe diameter, previous break history, interest rate, type of pipe, and aging rate of pipe. (Cassar-FRC)
W82-05673

SITE INVESTIGATION AND MATERIALS SAVE MONEY ON SALLENTE.
World Water, Vol 5, No 4, p 31-32, April, 1982, 3 Fig.

Descriptors: *Hydroelectric plants, *Geological surveys, *Concretes, Embankments, Dam design, Sallente Dam, Spain, Asphaltic concrete, Rockfill dams.

The Sallente Dam, under construction in the Spanish Pyrenees, is interesting for three reasons: its single layer asphaltic concrete upstream facing, the thorough site investigation which resulted in moving the dam's design location 100 m downstream to a site on a much shallower layer of glacial fill, and careful trials of embankment materials suitable for the low temperature and high altitude. Considerable cost savings and increased safety in design were attained as a result of the detailed studies. The dam is 398 m long, 89 m high, and 10 m wide at the crest, with a storage capacity of 6.2 cu hm. (Cassar-FRC)
W82-05878

HYDRO POWERS MINDANAO DEVELOPMENT PLANS,
A. Bingham.
World Water, Vol 5, No 4, p 23, 25, 27, April, 1982. 2 Fig.

Descriptors: *Hydroelectric power, *Water resources development, *Industrial development, Mindanao, Philippines, Agus River, Pulangi River.

Hydroelectric power development on the Agus and Pulangi Rivers in Mindanao, the Philippines, has encouraged economic development on this mineral-rich island, the scene of four centuiries of conflict between the government and a Moslem group. Potential power capacity of the rivers is 900 MW each. On the Agus River, which drops 700 m from Lake Lanao to the sea, two of seven planned dams have been completed, four are under construction, and one is in the planning stage. A 255 MW hydropower plant on the Pulangi River is scheduled for completion in 1985. Further development on the Pulangi faces expensive land acquisition costs. At present 75% of the island's generating capacity comes from hydropower plants with low operating costs. By 1986 the proportion is expected to be 90%. (Cassar-FRC)
W82-05881

8B. Hydraulics

THEORETICAL AND EXPERIMENTAL STUDIES ON DYNAMIC STRUCTURE-FLUID COUPLING,
Trabzon Univ. (Turkey).
D. Altinisik, H. Karadeniz, and R. T. Severn.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 71, No 3, p 675-704, September, 1981. 23 Fig, 4 Tab, 16 Ref.

Descriptors: *Fluid mechanics, *Dams, *Resonance, Earthquakes, Arch dams, Vibrations, Pressure distribution, Hydrodynamics, Finite element method, Computer programs.

The structure-fluid coupling process has been expanded by incorporating a greater variety of finite elements into the computer program, especially the three-dimensional isoparametric element for use with doubly curved structure-fluid interfaces, as exemplified by an arch dam. Tests on cones and thin cylinders containing water and on a model arch dam and reservoir produced results which agreed with calculated results. The objects were subjected to multipoint resonance testing and excitation on a shaking table. A simulated earthquake was applied to the model dam and reservoir. (Cassar-FRC)
W82-04755

MAXIMUM PRESSURE DURING WATER HAMMER ACCOMPANIED BY DISCONTINUITY OF THE FLOW,
V. V. Tarasevich.
Hydrotechnical Construction, No 8, p 784-790, August, 1980. 4 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 15-18, August, 1980.

Descriptors: *Flow characteristics, *Mathematical equations, Pipelines, *Pipe flow, *Design standards, Pressure heads, High pressure, Cavitation, *Hydraulic engineering.

Discontinuity of a fluid flow is often observed during water hammer in pipeline systems and conduits of hydroelectric stations in the form of various cavities. When these cavities collapse, a considerable increase of pressure can occur. Equations are developed for determining the maximum value of the excess of pressure which occurs upon the collapse of a cavity based on an approximate solution of the problem of water hammer accompanied by discontinuity of flow. These equations make it possible to avoid excessive factors of safety when designing pipelines. (Carroll-FRC)
W82-04772

CALCULATION OF LOCAL SCOUR OF ROCK FOUNDATIONS BY HIGH-VELOCITY FLOWS,
I. I. Taraimovich.
Hydrotechnical Construction, No 8, p 791-797, August, 1980. 4 Fig, 2 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 19-22, August, 1980.

Descriptors: *Spillways, *Flow characteristics, *Mathematical equations, Jets, *Scour, Rocky soils, Rocks.

In order to solve the problem of local scour in rocky soils occurring beyond spillways with buckets, it is first necessary to know the characteristics of the flow on the spillway for both the nappe and submerged jet. Data from seven spillways are used to develop equations for the determination of the curve of the change in the relative length of the jet with change in the Froude number, the curves of the relative thickness of the jet and core as a function of the relative length of the jet, the curves of the coefficient of breakup of the jet as a function of the Froude number, and the curves of the range of takeoff of the jet from the bucket as a function of the Froude number. Differences between the values determined through these calculations and laboratory values are discussed. (Carroll-FRC)
W82-04775

A FINITE-DIFFERENCE METHOD TO EVALUATE WATER HAMMER PHENOMENA,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
J. L. Sanchez Bribiesca.
Journal of Hydrology, Vol 51, No 1-4, p 305-311, May, 1981. 1 Fig, 2 Ref.

Descriptors: *Mathematical models, *Mathematical equations, *Finite difference methods, Water hammer, Cavitation.

The method of characteristics has generally been preferred for evaluating water hammer effects. However, in some instances, such as when water column separation is expected, finite-difference procedures may be more suitable. The development of a simple finite-difference method for evaluating water hammer phenomena which is as fast as the characteristics method is demonstrated. The method, which is based on some matrix properties, does not require the solution of a system of linear equations at each of the computing steps, as is usual with finite-difference models. In addition, this method can easily take into account more of the involved factors than are usually considered in the classical procedure. The procedure has been successfully applied to traditional problems. (Carroll-FRC)
W82-04799

THE ROTATING HYDRAULICS OF THE OPEN-CHANNEL FLOW BETWEEN TWO BASINS,
Washington Univ., Seattle. Dept. of Oceanography.
C. Y. Shen.
Journal of Fluid Mechanics, Vol 112, p 161-188, 1981. 10 Fig, 2 Tab, 13 Ref.

Descriptors: *Fluid mechanics, *Open-channel flow, Flow, *Hydraulics, *Flow characteristics, Weirs, Mathematical equations.

Theoretical and experimental investigations of rotating weir flow are presented. Three problems are discussed: constant potential vorticity flow over a submerged weir, in which sill height is below the free surface level of the fluid in the downstream reservoir as opposed to the case in which the free surface is below the sill; controlled zero potential vorticity flow through a channel of irregular cross section; and supercritical separation of the current. In the first problem flow is found to depend on the fluid level in the downstream basin when the fluid level there is high and to become independent of the fluid level downstream as soon as the level falls below a critical height. Transport of the flow decreases whenever rotation rate or upstream potential vorticity is increased. In the second problem transport of the flow increases at some moderate rotations if the channel floor has a cross-channel slope similar to that of the surface of the current. Otherwise, the transport always decreases with rotation rate. In the final problem where the current separates from the left wall of the channel, visual evidence is obtained and measurements of formation of such a boundary current are also secured. Comparisons between theory and experiment for the three cases are generally reasonable except when flow separates in the control section. The theory is not applicable to such separation. (Baker-FRC)
W82-05083

STEADY SHALLOW FLOW OVER A SPILLWAY,

Asian Inst. of Tech., Bangkok (Thailand).
N. S. Sivakumaran, R. J. Hosking, and T. Tingsanchali.
Journal of Fluid Mechanics, Vol 111, p 411-420, 1981. 9 Fig, 11 Ref.

Descriptors: *Fluid mechanics, *Spillways, Overflow channels, Flow, Fluid flow, *Spillway crests, Streamflow, Low flow, *Mathematical equations, Steady flow.

A simple derivation of recent shallow-flow equations is presented, with bed curvature. These equations are applied to steady flow over a high overflow spillway crest, to obtain the head discharge relationship and the crest pressure distribution in good agreement with experimental results. The equations are apparently valid for quite large negative curvatures. Their application to steady flow over a spillway toe indicates that they are valid for positive curvature to a more limited extent. (Baker-FRC)
W82-05086

FINITE-AMPLITUDE STABILITY OF AXISYMMETRIC PIPE FLOW,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
A. T. Patera, and S. A. Orszag.
Journal of Fluid Mechanics, Vol 112, p 467-474, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Pipe flow, *Fluid mechanics, Flow, Pipes, Pipelines, *Mathematical equations, Navier-Stokes equations, Reynolds number, *Axisymmetric pipe flow.

Spectral methods were used to investigate numerically the behavior of finite-amplitude axisymmetric disturbances in pressure driven pipe flow. The basic question concerns the existence of finite-amplitude equilibrium states of this flow. If such states do not exist, then pipe flow is stable to all axisymmetric disturbances. No evidence was found of finite-amplitude equilibria at any of the wavenumber/Reynolds number combinations investigated, with all perturbations decaying on a time scale much shorter than the diffusive (viscous) time scale. Decay was obtained where amplitude-expansion perturbation techniques predict equilibria, thus indicating that these methods are not valid away from the neutral curve of linear stability theory. The results of this study indicate that the method of false problems is not a valid procedure for investigating finite-amplitude axisymmetric perturbations to pipe flow. (Baker-FRC)
W82-05087

DETERMINATION OF THE OPTIMAL HEIGHT OF THE BUCKET LIP OF A SKI-JUMP SPILLWAY,
A. N. Butakov.
Hydrotechnical Construction, Vol 15, No 6, p 335-341, June, 1981. 7 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 19-23, June, 1981.

Descriptors: *Spillways, *Design criteria, Hydraulics, Dams, Equations.

Equations are developed for determining the optimal lip height and corresponding angle of descent of a water jet from the lip for providing the maximum flight distance of the jet. These equations are suitable for calculating cantilever ski-jump spillways. Three examples are given to illustrate the equations in practical situations. The first example was that of determining the position of the lip of the chute providing the greatest flight of the jet. The second proposed determining the optimal position of the spillway lip providing maximum flight of the jet and the distance of the flight in the case of a discharge of floodwaters over a spillway of standard crest shape. In this case the effect of aeration of the flow on the flight distance of the jet had to be taken into account. The third case involved examining spillway designs in order to provide the greatest flight distance of the jet from the dam site in the case of an arch dam supporting a head of 225 m. Spillway variants were an overflow spillway with a crest head of 5.5 m and a rectangular spillway passing through the dam at a depth of 100 m from the upper pool level. (Cassar-FRC)
W82-05107

CALCULATION OF LARGE UNLINED CANALS,
R. I. Samedov.
Hydrotechnical Construction, Vol 15, No 5, p 289-293, May, 1981. 4 Tab, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 25-28, May, 1981.

Descriptors: *Canal design, *Hydraulic properties, *Soil physical properties, *Scour, Soil mechanics, Channel scour, Diversion channels, Azerbaidzhan, Silting, Bank erosion, Soil stability, Stable channels, Deformation, *Geokchai River, *USSR.

Calculation of hydraulic properties of large unlined diversion canals should be based on physical and mechanical properties of the soils. For cohesive soils the angle of internal friction and the slope angle are frequently not equal. The diversion canal of the Geokchai River in Azerbaidzhan SSR was investigated. This canal receives unregulated river runoff. Hydraulic parameters and physical and mechanical properties of the soils for eight reaches of the 13 km canal are presented in a table. Scouring is occurring in the 2-5 km reach, and silting and bank deformation is found in the 10-13 km stretch. The scoured section has a relative channel width 10 fold less and a parameter M of about 1.4 in the scouring section and 0.5 in the silting section. The discharge was the same in all sections of the canal. Therefore, the parameter M cannot be used alone to characterize channel deformation. (Cassar-FRC)
W82-05131

HYDRAULIC MODEL STUDIES OF LANDSLIDE-GENERATED WATER WAVES-MORROW POINT RESERVOIR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224452, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-82-9, April 1982. 60 p, 16 Fig, 2 Tab, 7 Ref, 2 Append, including 156 p of microfiche.

Descriptors: *Landslides, *Hydraulic models, *Wave height, *Model studies, Waves, Solitary waves, Reservoirs, Bores, Dams, Dam overtopping, *Marrow Point Dam, Colorado.

Morrow Point Dam is a double-curvature, thin-arch concrete dam located on the Gunnison River 40 km east of Montrose, Colorado. A number of major landslide areas are located upstream from the dam. Under certain conditions it is possible that a slide could break free and plunge into the reservoir at velocities greater than 30 m/s. A physical model study was conducted to determine the magnitude of waves in the event such a landslide occurs. The model of 4.8 km of the reservoir and 1.3 km of the downstream canyon was constructed to an undistorted scale of 1:250. A wedge-shaped slide was used. It was found that the direction of the landslide as well as the volume of water displaced and slide velocity are important to the wave height in the vicinity of the slide. Waves directly in line with the slide direction were two to three times higher than waves not in line with the slide. Waves distant from the slide were solitary waves. Waves in the river downstream were bore waves. The maximum wave height at the dam due to a slide at one of the selected sites was 7 m. Nondimensional relationships were developed to predict wave heights for Morrow Point Reservoir and other cases as a function of slide velocity, water depth at the slide, volume of water displaced, and distance from the slide. (Moore-SRC)
W82-05211

EROSION BY PLANE TURBULENT JETS,
Alberta Univ., Edmonton.
N. Rjaratnam.
Journal of Hydraulic Research, Vol 19, No 4, p 339-358, 1981. 11 Fig, 2 Tab, 20 Ref.

Descriptors: *Erosion, *Jets, Dimensional analysis, Scour, Channel erosion, Mathematical studies, Hydraulics, Sand, Gravel, Laboratory studies, *Hydraulic engineering, Soil types.

Erosion of loose beds of sand, gravel, and such other materials as clay and weak rock is a problem of considerable importance in hydraulic engineering. Such erosion may be caused by flow concentration, local flow acceleration, secondary flow, vortices, or high velocity jets. Previous studies have shown that at some point in the erosion process, the maximum depth of erosion or any other length scale of the erosion process increases linearly with the logarithm of time from the start of the erosion process and that, as times increases, the characteristic lengths eventually reach an end or asymptotic state. This paper presents the results of a continuing study of erosion caused by submerged plane wall jets of air and water on beds of sand and polystyrene and by submerged impinging plane jets of water and air on beds of sand. Dimensional analysis was used to study the characteristic features of the scroured bed in the asymptotic state. The maximum depth of erosion for the asymptotic state, in terms of the height of impingement, was found to be primarily a function of the densimetric Froude number and the total thickness of the jet. The functional relationship between these factors was different for air-sand and water-sand systems, apparently due to the mode of transport of the eroded bed material out of the scour hole. The profile of the eroded bed, at least in the scour hole portion, was found to be similar for the air and water series. (Carroll-FRC)
W82-05277

AN INVESTIGATION OF A JET-ASSISTED HYDRAULIC JUMP,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering.
P. W. France.
Journal of Hydraulic Research, Vol 19, No 4, p 325-337, 1981. 12 Fig, 5 Ref.

Descriptors: Dam design, *Hydraulic jump, *Jets, Fluid mechanics, Flow patterns, Kinetic energy, *Spillways.

Dissipation of the kinetic energy of the flow of water over a dam spillway is essential if dangerous scour in the natural channel below the structure is to be avoided. The most effective and widely used method for reducing the energy of the falling water is the formation of a hydraulic jump in a stilling basin at the toe of a spillway. Baffle piers, chute blocks, and sills are the traditional means used to stabilize the jump. The use of jets of water issuing from underneath the formation of a hydraulic jump which requires a smaller tailwater depth. theoretical analysis of the jet-assite hydraulic jump is presented in graphic form and verified experimentally using a specially designed model which fits into a small closed-circuit laboratory flume. Although the stabilization of the jump is dependent on a number of parameters, the angle of inclination of the jets appears to have the most significant effect. (Carroll-FRC)
W82-05279

SURVEY OF PRESENT KNOWLEDGE ON CAVITATION IN LIQUIDS OTHER THAN COLD WATER (THERMODYNAMIC EFFECT),
International Association of Hydrological Sciences, Paris (France).
J. Bonnin, M. L. Billet, F. G. Hammitt, and B. Chaix.
Journal of Hydraulic Research, Vol 19, No 4, p 278-305, 1981. 4 Fig, 31 Ref.

Descriptors: *Cavitation, *Thermodynamics, *Fluid mechanics, Hydraulics, Evaporation, Water pressure, Mechanical equipment, *Temperature effect.

Although in the past the study of bubble behavior from a purely mechanical point of view was considered adequate for explaining the main features of cavitation, it is now understood that thermodynamic effects may interfere with bubble behavoir when the physical properties of a liquid are other

than those of cold water. These thermodynamic effects are primarily the result of the greater specific mass of the vapor and the heat of vaporizaiton. This paper summarizes the current state-of-the-art with respect to research regarding thermodynamic effects on cavitation. The required net positive suction head for pump tests in hot water and other liquids is less than that for tests with cold water, and cavitation erosion is less violent. Cavitation inception is delayed by thermodynamic effects, which depend on numerous parameters. The heat of vaporization is drawn from the surrounding liquid, causing a drop in temperature in the cavity which is connected with a lower pressure of vaporization. Adequate grouping of parameters permits comparison between fluids and test facilities, and even transporition of test results between different models, such as ogives, venturis, and pumps. Cavitation erosion is influenced by a wide range of parameters, and it is not yet possible to classify the amount and rate of this erosion. (Carroll-FRC)
W82-05280

AN EVALUATION OF TWIN WELLS FOR USE WITH WATER SOURCE HEAT PUMPS,
Louisana State Univ., Baton Rouge. Dept. of Civil Engineering.
J. R. Buller, Jr.
M.S. Thesis, May 1981. 96 p, 15 Fig, 51 Tab, 20 Ref. OWRT A-046-LA(2).

Descriptors: *Heat exchangers, *Heat transfer, *Pump wells, *Cost-benefit analysis, Drilling, Heated water, Cooling, Wells, Pump testing, Pumping tests, Pumps, Cost analysis, Air conditioning, Economic feasibility, Economic evaluation, Economic efficiency, Input-output analysis, Water use, Saline water intrusion, Seepage, Groundwater, Installation, Civil engineering, Dug wells, Well water, Louisiana.

A cost-effectiveness assessment in two Louisiana Parishes on water source heat pumps (with a set of twin wells supplying the groundwater heat source/sink) and conventional air source heat pumps revealed that the former will reduce operating costs 20-30% relative to the latter. The installation costs of water source heat pumps are greater than conventional systems due to the drilling cost of the supply and recharge wells. The total well drilling depth controls the cost-effectiveness. The return of reusable heat pump effluent water via the twin well system will avoid harmful side effects of salt water intrusion and excessive lowering of water levels caused by groundwater withdrawals. The break-even drilling depths for water source heat pumps was 90 and 100, 170, and 125 and 80 ft for residential, commercial, and industrial pumps, respectively, for the two Parishes. For depths greater than the break-even point, conventional systems were computed to be less costly. However, high efficiency water source heat pumps having heating and cooling coefficients of performance of 4.5 and 4.0, respectively, are possible. The economic break-even point drilling depth may be increased if the costs of such pumps are below $250, $150, and $100 per ton for residential, commercial, and industrial heat pumps, respectively. (Zielinski-MAXIMA)
W82-05307

NORTHERN ELBE CULVERT,
Hamburg City Drainage (Germany, F.R.).
E. Kuntze.
Water Science and Technology, Vol 14, No 1/2, p 263-268, 1982. 3 Fig.

Descriptors: *Culverts, *Sewer systems, *Wastewater collections, Water conveyance, Storm water, Elbe River, *Hamburg, *Germany, Drainage systems, Air cushion culverts.

An air cushion culvert under the northern Elbe River is part of a sewer reconstruction in the city of Hamburg, West Germany. A large air pocket formed by pumping air into the pipe between bulkhead walls allows adjustment of the discharge cross section to fit variable flow. This procedure maintains a flow velocity high enough to prevent sediment accumulation. The Elbe culvert is 610 m long, with inflow and discharge diameters of 3500 mm and 2 pipelines of 2400 mm each. Equipment for operation of the culvert includes inlet and outlet piping in the shape of a siphon, air supply mechanisms, filling depth control, and ventilation. Trial operation using clean water begun in autumn of 1980 indicated that flow velocities had to be corrected upwards by 10-15%. (Cassar-FRC)
W82-05427

WATER HAMMER,
For primary bibliographic entry see Field 8C.
W82-05432

ESTIMATING WATER FLOW UNDER GATES,
A. Zanker.
International Water Power and Dam Construction, Vol 33, No 12, p 50-51, December, 1981. 2 Fig.

Descriptors: *Flow rates, *Mathematical equations, *Gates, Nomograms, Hydraulics, Water flow, Water levels.

The flow of water under a vertical gate may be assumed to be the same as the flow of water through a square orifice, provided that the opening height is small when compared with the upstream and the downstream water levels. Direct use of the equation for the rate of flow is made difficult by the uncertainty involved in measuring the depth of water at the vena contracta. Solution of the equation generally is accomplished through a lengthy procedure involving computation of the upsteam water level to gate opening height ratio and determination of two coefficients dependent on this ratio. This paper presents a simple method of estimating the flow rate under a straight gate using a nomogram. Both the nomogram and instructions for its use are included. (Carroll-FRC)
W82-05514

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
R. G. Kazmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232018, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 9, December, 1981. 68 p, 28 Fig, 22 Tab, 16 Ref, 1 Append. OWRT A-046-LA(3).

Descriptors: *Heat exchangers, *Heat transfer, *Wells, *Pump wells, *Cost-benefit analysis, Heated water, Drilling, Cooling, Pump testing, Pumping tests, Cost analysis, Civil engineering, Input-output analysis, Air conditioning, Water use, Economic efficiency, Economic evaluation, Aquifer management.

The feasibility of the installation and operation of twin wells and water source heat pumps was evaluated for two typical Louisiana parishes. The use of such a system for energy conservation was determined to be safe and feasible. The two wells should be used in an alternating manner as the water source; one for production, one to return water to the aquifer. This mode of operation is used to eliminate any impact on groundwater levels, and to prevent interfering with other users of the same aquifer. Tables are included for determining the physical spacing between the production and return wells for any combination of aquifer thickness, length of season, and rate of water production, such that the returned water will not appear in the production stream. Economic analyses covered residential, commercial, and industrial applications for the two parishes. All hydrogeological data required for the development of preliminary designs are provided on the included maps. It is concluded that a water-source heat pump and a single well combination is almost always the most significant efficient installation to produce the required heating and cooling. In many locations in the two parishes, the twin well heat pump system will be economical. (Zielinski-MAXIMA)
W82-05535

FORMATION OF A STABLE CANAL CHANNEL,
M. M. Selyametov.
Hydrotechnical Construction, Vol 15, No 7, p 418-423, 1981. 6 Fig, 2 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 27-30, July, 1981.

Descriptors: *Canal design, *Flow velocity, *Slope stabilization, Froude number, Design criteria, Channel scour, Sand, Velocity, Hydraulic engineering, Canal linings, Channel morphology, Stable channels.

Several methods of designing stable canal channels were investigated experimentally in sands of 0.2 mm particle size. Two accepted procedures were found: (1) choose a cross-sectional shape and a flow velocity regime so that the Froude number in any location does not exceed the permissible Froude number, and (2) reinforce the side slopes in regions where Froude numbers are too high. (Cassar-FRC)
W82-05584

WHERE TO PUT A STEADY DISCHARGE IN A RIVER,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5G.
W82-05632

OPTIMUM DEPTH AND SPACING OF SUBSURFACE DRAINS,
Marathwada Agricultural Univ., Parbhani (India).
H. S. Acharya, and D. G. Holsambre.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 77-80, March, 1982. 1 Fig, 4 Ref.

Descriptors: *Mathematical studies, *Subsurface drains, *Drain spacing, *Construction costs, Mathematical equations, Drains, Tile drains, Drainage systems, Subsurface drainage, Tile drainage, Drainage practices, Water table profiles.

Proper choice of depth and spacing of drains can help to minimize the cost of installing a subsurface drain for use in agriculture. An analytical solution which yields formulas for the direct determination of depth and spacing that minimize the cost is presented. The present solution does not require numerical techniques, but rather utilizes various constraints on the water table height in the Hooghoudt's formula for estimating water table heights between tile drains. The optimum location for the subsurface drain is taken from one of the vertices of the set of feasible solutions to two simple equations, and the optimum solution is obtained by direct verification. (Geiger-FRC)
W82-05693

SOME CHARACTERISTICS AND IMPLICATIONS OF DRAINAGE BASIN LINEARITY AND NON-LINEARITY,
Nebraska Univ., Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05710

LINEAR AND NONLINEAR RUNOFF FROM LARGE DRAINAGE BASINS,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05711

DISPERSION IN TUMBLING FLOW,
Canada Centre for Inland Waters, Burlington (Ontario).
S. Beltaos.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 591-612, April, 1982. 10 Fig, 4 Tab, 22 Ref.

Descriptors: *Flow profiles, *Turbulent flow, Flow measurement, Model studies, Mathematical equations, Streams, Rivers, Hydraulics.

Results are presented of several dispersion tests in a rectangular flume, plus an analysis based on two different theoretical models. The rectangular flume was divided into a series of pools by placing triangular weirs at equal distances along the flume, causing a flow pattern considered to represent a first approximation to the tumbling flow regime seen in prismatic laboratory channels and in many rivers. The study allowed several conclusions. The time of travel in a series of pools and falls can be calculated in a straight-forward manner. It is equal to the time of travel for one pool times the number of pools. With suitable choice of the dispersion parameters, the river dispersion model provides satisfactory predictions of observed dispersion characteristics. Moreover, the dispersion parameters appear to correlate plausibly with hydraulic stream characteristics. Thus, the river dispersion model may eventually prove realistic for mountain stream dispersion. However, field data are needed to enable practical application. With suitable choice of the pool residence time, the storage dispersion model gives satisfactory predictions of dispersion characteristics. However, it is unclear whether this model is realistic, and its partial agreement with the data may have been fortuitous. (Baker-FRC)
W82-05796

OUTFALL DIFFUSER BEHAVIOR IN STRATIFIED AMBIENT FLUID,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. J. Wright, D. R. Wong, K. E. Zimmerman, and R. B. Wallace.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 483-501, April, 1982. 12 Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater outfall, *Mathematical equations, Stratification, Mixing, Destratification, Model studies, Hydraulics.

A method is presented for the preparation of design charts for estimating the mixing behavior from outfall diffusers in stagnant stratified ambient fluids. Numerical analyses by traditional integral methods which consider the interaction and merging of individual port discharges are used to predict the diffuser behavior. Predictions for the maximum height of plume rise and minimum dilution at that point are presented in the form of design curves. Experimental data for the cases of a single and opposing rows of horizontal ports are presented and compared to the numerical results. Additional data on the thickness and vertical location of the horizontally spreading layer developed after the maximum rise is reached are presented. The numerical model was found to be inaccurate for cases of discharges with significant initial momentum. A criterion is developed to indicate when this effect will be important. (Baker-FRC)
W82-05797

FLOW RESISTANCE IN WIDE RECTANGULAR CHANNELS,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Civil Engineering.
W. R. C. Myers.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 471-482, April, 1982. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Flow resistance, *Open channels, Pipe flow, Mathematical equations, Hydraulics, Flow friction, Hydrantic friction, Reynolds number.

This work is part of a wider study into flow resistance in channels that have floodplains. Flow over the floodplains is characterized by low depths and velocities, low Reynolds numbers, high relative roughness and large width-to-depth ratios. Flow in the central channel will exhibit greater depths, velocities and Reynolds numbers, lower relative roughness, and smaller width-to-depth ratios. The work is aimed at investigating the variation of friction factor with Reynolds number and width-to-depth ratio for hydrodynamically smooth flow. Friction factors have been measured in a rectangular open channel covering width-to-depth ratios of 1-35 and Reynolds numbers of 6,000-168,000. The relationship between friction factor and Reynolds number has been found not to conform to the pipeflow relationship. On the average open channel factors are around 8% higher than those for pipes at the same Reynolds number. The results have been compared with other investigations, showing agreement on the general form of the friction factor and Reynolds number relationship, but differences of the numerical constraints in the equation. The relationship of friction factor to width-to-depth ratio has been shown to be complex, influenced by secondary circulation and channel shape. The methods of Pillai and Kazemipour and Apelt have been applied to the data, showing that their methods reduce the divergency between the open channel data and the pipeflow equation to less than 2%. Differences may be due to the inadequacy of the methods in taking into account the effects of secondary circulation. (Baker-FRC)
W82-05798

FLOW UNDER WEIR ON SCOURED BED,
Uttar Pradesh Irrigation Research Inst., Roorkee (India). Tehi Dam Div.
D. Kumar, G. C. Mishra, and S. Chandra.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 529-543, April, 1982. 8 Fig, 16 Ref.

Descriptors: *Weirs, *Flow profiles, Flow pattern, Flow rates, Barriers, Dams, Flow measurement, Flow characteristics, Flow around objects, Scour, Channel scour.

Using conformal mapping techniques an approximate analysis for seepage flow under a weir, resting on isotropic porous medium of infinite depth, with a vertical sheet pile at the toe and segmental circular scour commencing from the downstream end of the apron, has been obtained. An exact analysis for semicircular scour, using conformal mapping, is also presented. A comparison is made between the results of approximate and exact analysis for the semicircular scour of various depths. The maximum exit gradient is shown to be increased by about 75% in the case of semi-circular scour. For semi-circular scour profile, where s is the depth of sheet pile and b is the width of the floor, as s/b increases the point of maximum exit gradient shifts away from the sheet pile. The exit gradient distribution obtained from approximate analysis is very close to the one given by the exact analysis, but the potentials at salient points under the apron obtained from the two analyses compared closely for values of s/b up to 0.1. These analyses will be helpful to decide the value of safe exit gradient of hydraulic structures on permeable foundation. (Baker-FRC)
W82-05800

8C. Hydraulic Machinery

CALCULATION OF COMPLETE INTERCEPTION OF GROUNDWATER FLOW TO 'FULLY PENETRATING' EXCAVATIONS,
V. M. Grigor'ev.
Hydrotechnical Construction, Vol 15, No 6, p 351-356, June, 1981. 4 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 29-32, June, 1981.

Descriptors: *Seepage control, *Dewatering, *Excavation, Aquicludes, Aquifers, *Well hydraulics, Vacuum wells, Wells, fully penetrating wells, Capillary water, Pumping, Groundwater management, Interception, Design criteria.

Equations for calculation of complete interception of groundwater flow by vacuum wells are presented. These are useful in design and operation of wells and pumps for dewatering excavations which extend through an aquifer to the underlying aquiclude. The calculations include the physical seepage patterns and the temporal changes in water and air discharges. To simplify the calculations the dynamic level in the well and the vacuum in the above-water space are assumed constant. (Cassar-FRC)
W82-04902

RESONANCE IN HYDROPOWER STATIONS,
Chemin des Vignes, Pully Lausanne (Switzerland).
C. Jaeger.
International Water Power and Dam Construction, Vol 34, No 1, p 20-22, January, 1982. 16 ref.

Descriptors: *Hydroelectric plants, *Resonance, Mechanical equipment, *Design criteria, Pressure conduits, Turbines.

Possible resonance in pressure conduits can present difficulties for hydropower engineers. Several unforeseen pressure surges which occurred recently in large hydropower stations have caused increasing concern. Basic research in this area is summarized. The ability to foresee or predict resonance in hydropower stations calls for consideration of two points: the geometry of the system of conduits and the boundary condition. In some cases the period of the excitor is determined by its own physical characteristics. The calculations are far more difficult when there is reciprocal interaction between the boundary conditions and the system of conduits, causing auto-oscillations. When the period of the excitor is known, the danger of possible resonance can be checked on a model which could be either a laboratory model or a computer model. Higher harmonics developing in a system of three converging conduits can be analyzed with the generalized theory of waterhammer waves. It is likely that the location of the zero point next to the point of insertion of the three conduits is important for the formation of a system of steady waves. Any prediction on possible resonance occurrring in a system of hydraulic conduits requires spotting probable excitors. (Baker-FRC)
W82-04953

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,
For primary bibliographic entry see Field 6B.
W82-04954

TURBINES FOR ITAIPU,
Itaipu Binacional, Rio de Janeiro (Brazil).
J. De Moraes, J. Rodriguez, J. H. Gummer, and F. Del Brenna.
International Water Power and Dam Construction, Vol 34, No 1, p 28-33, January, 1982. 9 Fig, 5 Tab, 23 Ref.

Descriptors: *Turbines, *Testing procedures, Mechanical equipment, Quality control, *Hydraulic turbines, Construction, *Design criteria, Hydroelectric plants, Dams, Itaipu, *Brazil.

A model test for turbines is described, which is used for draft tube and spiral case pressure fluctuations. In measuring draft tube oscillations, two separate phenomena were observed. These were: a rotating core which obviously gives fluctuations in pressure when measured at a fixed point in the draft tube but does not result in a change of net head, and possible pulsations of that core which result in a change of net head across the turbine and hence a change of flow. A pure rotational draft tube vortex presents no problem, but a pulsating vortex does. Specific requirements are detailed for runners, shaft, bearings, shaft seal, lower bend, spiral case and stayring, head cover and bottom ring, regulating mechanism, draft tube liner and pit liner, governor, and quality control and inspection. (Baker-FRC)
W82-04955

FIELD TESTING AND OPTIMIZING EFFICIENCY OF HYDRO TURBINES,
Department of Energy, Idaho Falls, ID. Idaho Operations Office.
L. H. Sheldon.
International Water Power and Dam Construction, Vol 34, No 1, p 22-28, January, 1982. 10 Fig, 8 Ref.

Descriptors: *Hydroelectric plants, *Evaluation, Mechanical equipment, *Turbines, *Testing procedures, On site studies.

The advantages and techniques of conducting both absolute and relative efficiency tests of hydraulic turbines are outlined. The performance of large turbines is usually determined initially in model tests. However, prototype turbine installations always show some differences from their models, which alter their performance characteristics. Turbine model tests are still needed to determine the full performance capabilities of a particular machine, no matter what prototype testing is done. Model efficiency curves are usually determined to a high degree of accuracy. Inherent differences between a model with its test-stand instrumentation and a prototype with its powerhouse features cause some differences between the efficiency curves of the two. These differences are caused by such factors as efficiency stepup, powerhouse head determination, site differences, manufacturing differences, deflection differences, and wear. The two basic types of efficiency testing are the absolute and the relative, denoting whether the discharge is measured absolutely or in relation to some other known parameter. The absolute methods include: Gibson, Allen salt velocity, weir, piezometer traverse, current meter, sonic, and thermodynamic. Results from index testing may be used in several ways. (Baker-FRC)
W82-05010

WATER SYSTEM EFFICIENCIES,
F. Gay.
Water Well Journal, Vol 36, No 3, p 54-55, March, 1982.

Descriptors: *Pumps, *Energy, Submersible pumps, Energy conservation, Operating principles, Pump efficiency.

The operating principles of jet pumps and submersible pumps are reviewed as guidelines for designing energy-efficient water systems. Jet pumps are available for shallow or deep well use. The shallow well pump consists of a centrifugal pump in series with an ejector pump. Dependent on atmospheric pressure for moving water from the well level to the venturi tube inlet, shallow well pumps are limited to 25 ft in practice. A deep well jet pump operates in a similar manner, except that the ejector pump is submersed. The practical limit for deep well jet pumps is 180 ft. Submersible pump consist of several individual centrifugal pumps mounted in series. They are more efficient and initially more expensive than jet pumps. Efficiency of a pumping system will be maixmal if pumps and pressure tanks of proper capacity are chosen, proper pressure switch settings are selected (normally 20/40 psi for piston and shallow well pumps and 30/50 psi for submersibles and deep well jets), piping size is selected to minimize friction loss, and motor efficiencies are improved. (Cassar-FRC)
W82-05281

WATER HAMMER,
E. Butts.
Water Well Journal, Vol 36, No 3, p 63-65, March, 1982. 2 Fig, 3 Ref.

Descriptors: *Water hammer, *Flow control, *Pipe flow, Pipelines, Hydraulic systems, Pumping, Flow velocity, Water flow.

Water hammer is caused by the sudden stopping of flowing water in a pipe system. Formulas are given for calculating water hammer and for understanding the factors in its formation. Major components in the formulas are pipeline velocity, time of flow stoppage, and length of pipeline. Maximum surge pressures are obtained in pipes made of unelastic material. Water hammer can be minimized by operating a system properly--eliminating air entrapment in the pipeline, allowing sufficient time in closing valves so that the flow pattern can modify, and avoiding excessive flow velocity. Devices or construction materials available for protection against water hammer are quick-closing check valves to prevent reverse flow acceleration, water hammer arrestors (a capped riser or small hydropneumatic tank), surge anticipator valves, and strong flexible pipe. (Cassar-FRC)
W82-05432

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 8B.
W82-05535

THERMOCLINE DRAWDOWN ABOVE COOLING WATER INTAKES,
Ontario Hydro, Toronto. Flow Systems Lab.
E. E. M. Elsayed.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 31-37, 1982. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Thermocline, *Drawdown, Cooling water, Mathematical equations, Design criteria.

The purpose of this work was to present the derivation of an analytical expression relating the critical discharge associated with the incipient thermocline drawdown condition to the thermal structure of the water body and the geometric properties of the intake structure, and then to present experimental results and field measurements to verify this relationship. The expression was developed for an incipient drawdown of a thermocline into a submerged intake equipped with a circular cover. For specific thermal conditions at the intake location, the relationship found can be used to determine limiting design requirements for the geometry of the intake structure to prevent withdrawal from the upper warm water layer. The use of this equation may also be extended to other engineerng applications involving causes of stratification other than temperature differences, such as salinity differences or variations in suspended sediment load. (Baker-FRC)
W82-05560

USE AND DESIGN FEATURES OF THE PUMP UNIT OF THE UVV-3-6KM VACUUM GROUNDWATER LOWERING INSTALLATION,
A. L. Zatevakhin, L. A. Titov, K. S. Bogolyubov, and B. S. Krakovskii.
Hydrotechnical Construction, Vol 15, No 7, p 405-410, 1981. 4 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 19-23, July, 1981.

Descriptors: *Pumps, *Dewatering, *Groundwater level, Construction methods, Construction equipment, Design criteria, Performance evaluation.

The UV-3-6KM pump unit for lowering groundwater levels is described. This monoblock pump unit is smaller in weight and capacity than the well-known UVV-2 installation but belivers water to increased heights. Detailed descriptions and drawings of the new pump are given. Maximum water delivery is 12.5 liters per sec; maximum air delivery at a vacuum in the suction header of 0.075 MPa, 6.2 liters per sec; installed ejector capacity, 15 kW; weight, 790 kg; and size, 1800 x 780 x 1400 mm. It includes a 100 meter long suction header and 100 wellpoints. (Cassar-FRC)
W82-05587

USE AND INVESTIGATION OF WATER-JET PUMPS (EJECTORS) AT THE CHIRKEY HYDROELECTRIC STATION,
Z. L. Zelenevskii, V. V. Kononov, and I. N. Lukin.
Hydrotechnical Construction, Vol 15, No 7, p 411-413, 1981. 2 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 23-25, July, 1981.

Descriptors: *Pumps, *Hydraulic machinery, Jet pumps, Vibrations, Noise, Cooling, Hydroelectric plants, Chirkey hydroelectric station, USSR.

Water jet pumps were installed in parallel with the centrifugal pumps at the Chirkey hydrostation, USSR. The pumps are used to cool the generator and transformer. Other possible uses of water jet pumps at hydrostations are circulation of the water supply, pumping of the dam plug, emergency pumping of the hydrostation, drainage of the powerhouse, pumping water from turbine covers, and priming centrifugal pumps. Operating at a wide range of pressures (1.50-2 MPa), the pumps have efficiencies of 34-41%. The ejector pumps use about half the electrical energy of other pumps with similar capacity and reduce personnel requirements by 3%. Since the ejectors are very noisy (up to 107 dB), noise protection is required. Strong vibrations necessitate anchoring the pumps and connected pipes to walls or floors by steel anchors. (Cassar-FRC)
W82-05592

USING PUMPS AS SMALL TURBINES,
McGraw-Edison Co., Mountainside, NJ.
L. Shafer, and A. Agostinelli.
International Water Power and Dam Construction, Vol 33, No 11, p 58-59, November, 1981. 3 Fig.

Descriptors: *Pumps, *Turbines, Design criteria, Pump turbines, Hydroelectric plants, Cavitation, Performance evaluation.

Greater use of centrifugal pumps as turbines has been seen as a result of the increased interest in small hydro. Since these pumps are mass produced, they can cover a wider range of applications at a lower cost than comparable purpose-built turbines. The performance of a turbine can be predicted accurately from one set of operating conditions to another, and new turbine designs can be developed from existing designs. When a pump operates as a turbine, its mechanical operation is smooth and quiet, its peak efficiency as a turbine is essentially the same as its peak efficiency as a pump, and the head and flow at the best efficiency point as a turbine are higher than the pump input power at its best efficiency point. Just as with the pump, at any point in the machine where the local pressure drops to the vapor pressure of the liquid, cavitation damage can occur when vapor is formed. In most cases no design changes or modifications are needed for a pump to operate as a turbine. There is a rapidly increasing number of successful installations of pumps as power turbines. One such site is in New York City, where a 36 in pump is being used as a turbine and has been running without trouble since 1949. (Baker-FRC)
W82-05597

GENERATING POWER FROM COMPENSATING FLOW.
International Water Power and Dam Construction, Vol 33, No 11, p 59-60, November, 1981.

Descriptors: *Hydroelectric plants, Compensation, Powerplants, *Motz, *Rhone River, *France, Minimum flow, Hydropower units, Seasonal variation, Snowmelt, *Hydroelectric power.

A conventional hydroelectric powerplant was constructed on the Rhone River at Chautagne. It has two bulb units rated at 45 MW under a head of 17 m and a flow of 350 cu m/sec each. Following customary European practice, the station was constructed 'in the dry', and water is conveyed to it through a canal, bypassing a short section of river. A minimum flow, in this case 10 cu m/sec, is required to be maintained in the original flow channel, and is called the compensating flow. At Motz, few km above the Chautagne power station, a small hydro plant was installed to produce about 10 GWh per year from two turbines rated at 750 kW at a head of 9.5 m. One unit will operate in winter and both in summer, when the snowmelt increases flow. The generators (induction machines) are small and are less expensive than corresponding synchronous machines. The reactive power needed for the machines is supplied by capacitors. Monitoring and command programming differ slightly from those for other systems. Performance and condition are monitored by a programmable microprocessor covering parameters such as oil fow, temperature, speed, current, and voltage. The unit also switches the generators on and off according to a program which can be

modified on site. Motz will eventually be operated by remote control. The design will probably be replicated at other stations which the Compagnie Nationale du Rhone is planning to build. Use of compensating flow for power generation is being promoted by environmentalists in France. (Cassar-FRC)
W82-05624

USING PUMP CURVES AND VALVING TECHNIQUES FOR EFFICIENT PUMPING,
Hilsdon and Sonnenburg, Memphis, TN.
C. W. Hilsdon.
Journal of the American Water Works Association, Vol 74, No 3, p 157-159, March, 1982. 7 Fig, 2 Tab.

Descriptors: *Pumps, *Design criteria, *Graphical analysis, Pumping head, Pressure head.

System head curves are given to aid in pump selection for single- and multiple-pump installations. The total dynamic head (the difference between suction and discharge heads) is beneficial in determining the approximate pump size and required horsepower. The system head curve is developed by determining the total dynamic head at various capacities above and below the normal operation condition. The curve may be expanded to consider the variation in water surface levels of the storage vessels on both sides of the pump and to consider the effects of capacity regulation devices. System head curves are given for five situations: a typical single-stage constant-speed pump, variation of impeller diameter at constant speed, variation of centrifugal pump speed, parallel operation of more than one centrifugal pump, and series operation of more than one centrifugal pump. In general, for parallel centrifugal pump operation the capacities can be added, and for series centrifugal pump operation the heads can be added. (Cassar-FRC)
W82-05666

SEWAGE PUMPING STATION SPLIT FOR MAINTENANCE,
Wilson and Co., Witchita, KS.
For primary bibliographic entry see Field 5D.
W82-05719

COROBICI COMPLETION ENSURES COSTA RICA'S POWER OUTPUT.
World Water, Vol 5, No 3, p 17-19, March, 1982.

Descriptors: *Hydroelectric power, *Tunnels, Corobici, Arenal, *Costa Rica, Concrete technology, Hydraulic structures, Water resources development.

A year's delay was experienced in the construction of Costa Rica's Arenal-Corobici hydroelectric power system, total capacity 331 MW. A test filling of the Arenal tunnel and subsequent inspection revealed cracks 20-30 mm wide for a distance of 1 km upstream of the surge tank, which is unusually large (88 m high, 18 m diameter). Cracks were repaired with shotcrete and the rock surrounding the tunnel was further grouted. Canals are under construction to carry the water from the turbines to arid farmlands. (Cassar-FRC)
W82-05755

PUMP INSTALLATIONS FOR REVERSE OSMOSIS SYSTEMS,
Weber Industries, Inc., St. Louis, MO.
W. Gordon, and R. Hensel.
Water Well Journal, vol 36, No 3, p 56-58, March, 1982. 1 Fig.

Descriptors: *Reverse osmosis, *Pumps, Equipment, Performance evaluation, Hydraulics, Matematical equations, Design criteria, Cavitation.

Suggestions for operating pumps in a reverse osmosis system are given. Pumps intended to supply multiple outlets must be sized according to the pressure and capacity at the extreme outlet. The booster pump, which develops the pressure required for the reverse osmosis process, must be operated dry, with insufficient pressure, or with air in the system. Available net positive suction head (the difference between total suction head at the pump suction and the vapor pressure of the liquid) must be equal to the required net positive suction head. The pump must be completely flooded before start-up. A diagram illustrates a typical priming system. All air must be expelled from the system when cartridges are changed. The supply line should exceed the inlet thread size 1 or 2 sizes. (Cassar-FRC)
W82-05882

8D. Soil Mechanics

CALCULATION OF THE TEMPERATURE REGIME OF HYDRAULIC FILL DAMS DURING THEIR CONSTRUCTION,
B. M. Skhundin, and Y. A. Popov.
Hydrotechnical Construction, Vol 15, No 5, p 273-278, May, 1981. 3 Fig, 11 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 5, p 15-18, May, 1981.

Descriptors: *Hydraulic fill, *Dam construction, *Soil temperature, Earth dams, Soil mechanics, Frozen ground, *Siberia, Boguchany Dam, *Temperature, Design criteria, Freezing, Thawing, Model studies, Mathematical models, Heat transfer, Ice.

A mathematical model permitted greater understanding of the temperature regime of the Boguchany hydraulic fill dam in Siberia. If the hydraulic filling season is started 22 days after the April 23 establishment of positive air temperatures, as the design specified, a 0.4-0.6 m thick thawed layer is present on the surface of the blocks at the start of filling. Complete thawing of the ground occurs by August 29. If the hydraulic filling season is started on April 23, a 0.6-0.8 m thick frozen soil layer remains in the block by the end of the hydraulic filling season. Improvements in construction methods suggested by the model were (1) remove thawed soil by bulldozers (2 cuts) so that filling can begin May 6 instead of May 15 and complete thawing can occur by the end of the season, (2) retain snow on the surface to reduce the depth of seasonal freezing, (3) heat the soil with an electric cable to reduce the depth of seasonal freezing, and (4) develop methods of using the natural heat stored in the soil of the borrow pit and in the water body. These measures extend the hydraulic filling season beyond the frost-free limits. (Cassar-FRC)
W82-04760

LARGE-SCALE EXPERIMENTAL INVESTIGATIONS OF FAILURE OF AN EMBANKMENT SLOPE UNDER DYNAMIC LOADS,
V. M. Lyatkher, Yu. K. Zaretskii, I. N. Ivashchenko, Yu. L. Zaslavskii, and G. S. Selezney.
Hydrotechnical Construction, No 8, p 773-777, August, 1980. 3 Fig, 2 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 10-12, August, 1980.

Descriptors: *Earth dams, *Dam stability, Dam foundations, Foundation failure, *Soil mechanics, Soil properties, Earthquakes, Seismic waves, Strength, Shear stress.

In order to develop more reliable methods for evaluating the seismic stability of earth dams, it is necessary to better define the mechanical properties of the soils used in the construction of these dams. A 35-meter-high embankment with a volume of about 40,000 cubic meters was constructed within the design contour of the upstream shoulder of the Nurek dam, and experimental collapsing of the slope of the embankment under the effect of seismic shooting was carried out. The experiments were conducted using materials of the actual granulometric composition placed with the use of the established procedure of dumping and compaction used in construction. Delayed firing of several rows of explosive charges was used to form a plane wave of seismic activity. The results of this large-scale experiment showed good agreement with calculations of the stress and strain and stability of an embankment slope under the effect of seismic shooting using current methods for the determination of the characteristics of the strength of coarse fragmental soils used for the construction of critical earth structures. (Carroll-FRC)
W82-04774

CONTROLLING THE QUALITY OF COMPACTION OF EARTH FILL IN THE CONSTRUCTION OF HIGH DAMS,
For primary bibliographic entry see Field 8A.
W82-05109

DESIGN OF THE COMPOSITION OF TRANSITION LAYERS OF ASPHALTIC CONCRETE MEMBRANES IN EARTH DAMS,
For primary bibliographic entry see Field 8A.
W82-05113

DYNAMIC ELASTIC AND ABSORBING PROPERTIES OF SOILS,
N. D. Krasnikov, G. S. Tolkachev, and L. A. Eisler.
Hydrotechnical Construction, Vol 15, No 5, p 279-284, May, 1981. 4 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 19-22, May, 1981.

Descriptors: *Stability analysis, *Seismic properties, *Soil dynamics, Soil mechanics, Dam stability, Soil physical properties, Dynamics, Elastic properties, Earthquake engineering, Shear stress, Ultrasonics, Stress analysis, Wave propagation, Earth dams, *Hydraulic structures, Design criteria, Foundation failure, Dam foundations.

The dynamic and seismic stability of hydraulic earth structures should consider the dynamic elastic and absorbing properties of soils, which depend on density, water content, static stress state, parameters of dynamic effects, and other factors. One group of methods for determining this dependence uses high frequencies (tens of hertz to hundreds of kilohertz) and low amplitude strains (about 10 to the minus 5th power). These methods (seismic propagation, seismic well logging, ultrasonics, and longitudinal and torisonal vibrations of specimens) produce higher moduli of elasticity and lower damping coefficients than observed, leading to overestimated loads for design purposes. A second group of methods (shear apparatus, stabilometers, stress-strain analysis, and propagation of blast waves) based on lower frequencies (units to tens of hertz) and higher amplitude strains (up to 0.1) produce estimates closer to those observed. Using these values can leas to more realistic design and avoid the extra costs of overdesign. It is advisable to conduct preliminary investigations of soil properties using the first group of methods followed by application of the second group to refine the results. (Cassar-FRC)
W82-05132

BEARING CAPACITY OF SAND BASES (DISCUSSION OF CONSTRUCTION SPECIFICATIONS),
V. N. Dombrovskii.
Hydrotechnical Construction, Vol 15, No 8, p 488-495, 1981. 7 Fig, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 38-42, August, 1981.

Descriptors: *Load distribution, *Sand, *Dam foundations, Soil mechanics, Bearing capacity, Slopes, Model studies.

Scale models were used to study the bearing capacity of sand bases for retaining structures (dams, etc.). Results of these experiments and of previous work were developed into a method for calculating the bearing capacity of sand bases for changes of angle of slope from 0 to 90 degrees. The method is usable if the founding depth does not exceed 1.5 of the width of the lower surface of a rectangular footing under an inclined load and 5.0 of the width of the lower surface under a vertical load. The ultimate load on a sand base of average or above average density for a square lower surface is 20-30% more than that of a strip, provided that the

width of the lower surface is constant and is determined by the coefficient of the slope of the lower surface. For a fixed angle of slope of the load and depth of the lower surface of the footing there is a relation between the angle of internal friction of the soil and the relative bearing capacity of the base. The ultimate load depends nonlinearly on the footing depth, which may be determined by an equation. (Cassar-FRC)
W82-05583

EMBANKMENT CONSTRUCTION: NEW MELONES DAM,
Army Engineers District, Sacramento, CA.
C. E. Stanage.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT4, p 621-636, April, 1982. 7 Fig, 1 Tab, 1 Ref.

Descriptors: *Embankments, *Dam construction, *Construction, Soil mechanics, Earth dams, New Melones Dam, California, Rockfill dams, Geology, Dam foundations, Excavation, Grouting.

Construction of the multipurpose New Melones Dam across a canyon on the Stanislaus River, California, is described. This zoned earth and rockfill structure is 637 ft high at the maximum, 1560 ft in crest length, and 15.9 million cu yd in volume. The impervious core is inclined upstream. Details are given concerning the site geology five distinct rock groups, meta-volcanic under the dam foundation); foundation excavation, preparation, surface treatment, and grouting; embankment features, materials, and sources of materials; construction procedures for the different types of fill; and instrumentation. (Cassar-FRC)
W82-05822

HYDRODYNAMIC EFFECTS IN EARTHQUAKE RESPONSE OF EMBANKMENT DAMS,
California Inst. of Tech., Pasadena.
J. F. Hall, and A. K. Chopra.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT4, p 591-597, April, 1982. 5 Fig, 8 Ref.

Descriptors: *Earthquake engineering, *Dam stability, *Hydrodynamics, Soil mechanics, Earth dams.

The significance of hydrodynamic effects in the earthquake response of embankment dams was evaluated using an analytical procedure based on the substructure method. Effects of dam-fluid interaction, water compressibility, and fluid-foundation interaction were all included. Hydrodynamic effects were relatively unimportant in the response of embankment dams to horizontal ground motion because the inertia forces associated with the large mass of the dam overshadowed the small hydrodynamic pressures produced by acceleration of the dam face. The dam response to vertical ground motion was small compared with that from horizontal ground motion. (Cassar-FRC)
W82-05823

SITE INVESTIGATION AND MATERIALS SAVE MONEY ON SALLENTE.
For primary bibliographic entry see Field 8A.
W82-05878

$12.6 M REPAIRS BILL FOR RUAHIHI CANAL.
World Water, Vol 5, No 4, p 8-9, April, 1982. 2 Fig.

Descriptors: *Canals, *Foundation failure, *Soil stability, Hydroelectric stations, Soil mechanics, Channel failure, Unstable channels, Artesian pressure, Seepage, Ruahihi Canal, New Zealand.

Repairs to the Ruhihi Canal, New Zealand, which collapsed on September 20, 1981, the day after the hydroelectric project was commissioned, will cost $12.6 million. A 1 km section of canal will be replaced by a steel or concrete pipeline. The remaining 2.35 km will be strengthened and drainage will be improved. The forebay structure, left stranded by the mishap, will be rebuilt 1 km upstream. The collapse, caused by unstable volcanic soils and artesian pressures, should have been predicted from borehole tests and knowledge of soil behavior. The insurers may refuse to honor the claim for damages because of design faults, and the Taurange Joint Generating Committee may have to look to the New Zealand government for financial help. (Cassar-FRC)
W82-05880

8E. Rock Mechanics and Geology

STRESS STATE OF A ROCK MASS WITH TWO PARALLEL TUNNELS WITH LOADING OF ONE OF THEM BY A UNIFORM INTERNAL PRESSURE,
R. A. Dunaevskii.
Hydrotechnical Construction, Vol 15, No 6, p 315-317, May, 1981. 1 Fig, 2 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 55-57, May, 1981.

Descriptors: *Tunnels, *Stress analysis, Rock mechanics, *Hydraulic structures, Contours, Diversion structures.

When two parallel unsupported tunnels are dug to discharge water during construction of hydraulic structures, it is desirable to calculate the stresses on the walls of unloaded and loaded tunnels. This paper considers tunnels with an inverted U cross section. In the loaded tunnel stresses on the half of the contour further from the unloaded tunnel are not dependent on the distance between the centers of the tunnel. However, at the closer wall, where it joins the bottom, stresses increase markedly with decreases in distance between tunnels. When the distance between tunnel centers is greater than 6 times the radius, the effects of the second tunnel can be neglected. Stresses on the contour of the unloaded tunnel also decreases in distance between tunnels. (Cassar-FRC)
W82-05116

STRUCTURE AND PERMEABILITY: GEOLOGIC CONTROLS ON INDUCED SEISMICITY AT NUREK RESERVOIR, TADJIKISTAN, USSR,
Columbia Univ., New York. Dept of Geological Sciences.
For primary bibliographic entry see Field 2F.
W82-05133

SEISMICITY IN THE MICA RESERVOIR (MCNAUGHTON LAKE) AREA: 1973-1978,
British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
R. M. Ellis, and B. Chandra.
Canadian Journal of Earth Sciences, Vol 18, No 11, p 1708-1716, November, 1981. 1 Tab, 6 Fig, 28 Ref.

Descriptors: *Reservoirs, *Seismology, *Earthquakes, *Dams, Stress, Seismographs, Damsites, Histograms, Faults, Geologic formations, Seasonal fluctuations, Water level, History, Geologic fractures, Structural geology. *McNaughton Lake area, *Canada.

Results of a program monitoring seismicity in the McNaughton Lake area of Canada are presented. The program began in 1973. It has located 212 earthquakes, most of which occurred in four sequences. Three sequences occurred in the Rocky Mountains near the McNaughton Lake Reservoir. The final sequence was located east of the Rocky Mountain Trench. Comparisons with historical records indicate that the seismicity pattern is similar to that of the historical record. It appears unlikely that impoundment induced the recent earthquakes. (Titus-FRC)
W82-05196

QUANTITATIVE RELATIONSHIP OF GROUTING TO THE REDUCTION OF GROUNDWATER FLOW THROUGH ROCK FOUNDATIONS,
Army Engineer District, St. Louis, MO.
M. J. Klosterman, T. F. Wolff, and N. G. Jahren.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 15-24, 1982. 7 Fig, 8 Ref.

Descriptors: *Grouting, *Seepage control, *Groundwater barriers, Rock testing, Foundation rocks, *Meramec Park Lake, *Missouri, Pumping tests, Dam foundations, Drill holes.

A test grout program was carried out at the proposed Meramec Park Lake damsite, Sullivan, Missouri. Two areas were grouted using two different methods: the modified stage-grouting method in the valley test area and the modified stop-grouting method in the upland area. Rock in the upland area was poor, with numerous small fractures. The test procedure involved pre- and post- grouting pumping tests from water wells surrounded by a 50-ft square grout curtain. After grouting, the specific capacity of the test wells was reduced by 81-97%. Considering that the bottom of the grout curtain box was open, it was determined that the grout effectively shut off groundwater flow. Optimum grout take was obtained with a mixture of 4:1 in primary and secondary holes and 6:1 in tertiary holes with addition of 2-4% bentonite. Pressures used were 1.5 psi per ft of hole depth except for the valley area, where artesian conditions required slightly higher pressures. There was no difference in grout take between AX size holes and NX size holes. Most grout injected did not spread more than 5 ft; most movement was along vertical joints rather than horizontal bedding planes. (Cassar-FRC)
W82-05201

8F. Concrete

CONSIDER SOIL-CEMENT FOR EROSION AND SEEPAGE CONTROL,
W. G. Dinchak.
American City and County, Vol 97, No 2, p 55-56, February, 1982.

Descriptors: *Erosion control, *Construction materials, *Cement, *Soil cement, *Linings, Soils, Erosion, Seepage, *Seepage control, Flood control, Drainage, Lagoons, Wastewater treatment, *Wastewater lagoons.

Soil-cement is a mixture of natural soils, portland cement, and water and has been used successfully as a paying material in the United States and Canada. Other uses have evolved due to its durability in exposures to sea water, domestic and industrial wastewaters, coal ash slurries, and brine solutions. Since 1965 soil-cement has been used in 25 wastewater treatment lagoons, the largest of which is in the Muskegon-Mona Lake facility in Michigan. Each of three lagoons is lined with eight inches of soil-cement. In Arizona, problems with runoff were solved by the use of soil-cement for embankment protection along arroyos. Soil-cement embankments constructed stairstep fashion also are used to protect about 6000 feet of shoreline at three villages on the north shore of the Gaspe Peninsula, Quebec, Canada. The soil-cement measures about 2.5 feet thick. A typical soil-cement mixture contains about 10% cement and 10% moisture. One particularly important property of soil-cement is its continuing strength gain after placement. High compressive strength is an important attribute when lining settling ponds and wastewater treatment lagoons. A soil-cement erosion-control facing can be placed in layers parallel to the slope. These layers also are typically about six inches in thickness. If the project includes seepage control, as in a lagoon, the bottom of the impoundment is covered with a 6 inch compacted layer of soil-cement. (Baker-FRC)
W82-05039

CONCRETE FOR SURFACES OF HIGH-HEAD SPILLWAYS,
L. N. Gomolko, I. S. Novikova, S. V. Sharkunov, and G. N. Tsedrov.

Group 8F—Concrete

Hydrotechnical Construction, Vol 15, No 5, p 302-307, May, 1981. 7 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 34-37, May, 1981.

Descriptors: *Cavitation, *Concrete mixes, *Spillways, Concrete additives, Erosion, Flow velocity, Aggregates, Ballast, Gravel.

A study of cavitation resistance of concrete showed that there was no clear-cut relationship between cavitation resistance and type of aggregate for high concrete grades. However, cavitation resistance was substantially increased by introducing additives or by reducing the water/cement ratio. Addition of sulfite yeast waste liquor (0.2% of weight of cement) increased cavitation resistance by 30-40%; hydrophobic silicone liquid (0.15%); and an epoxy compound containing diethylene glycol, by a factor of 3-5. A graph gives maximum permissible sizes of coarse aggregate as a function of flow velocity. Other graphs show the permissible height of an isolated projection for steady flow over concrete of 2 different grades. The permissible height of projections were plotted against flow velocity for ballast in concrete M300, for gravel in concrete M300, and for gravel plus ballast in concrete M400. The gravel-ballast in M400 permitted the largest projection height. These findings indicate that increased use of local gravel will reduce costs without increasing cavitation damage to concrete hydraulic structures. (Cassar-FRC)
W82-05110

SAFETY ANALYSIS OF HIGH HAZARD DETERIORATING CONCRETE GRAVITY DAM-RESERVOIR SYSTEMS INCLUDING CORRECTIVE MEASURE - EARTHQUAKE AND DYNAMIC STUDY,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-05296

RELAXATION IN CONCRETE,
Promon Engeharia SA, SAO Paulo (Brazil).
V. M. S. Lima, Q. M. Guedes, W. P. Andrade, and J. T. Bastos.
International Water Power and Dam Construction, Vol 33, No 12, p 27-32, December, 1981. 9 Fig, 3 Tab, 8 Ref.

Descriptors: *Concrete dams, *Creep, *Stress-strain curves, Stress analysis, Concrete technology, Mass concrete, Mathematical studies.

Concrete relaxation curves for mass concrete are usually calculated by numerical methods, using creep curves as a starting point. Details obtained from site tests of concretes used in the construction of the Tucurui and the Itumbiara hydroelectric plants in Brazil are used to assess the accuracy of three methods of calculating relaxation curves for concrete from creep data. Relaxation curves were calculated by the following three processes: numerical solution of the integral equation expressing the relaxation phenomenon; average logarithm; and Carlson's method, in which the relaxation function is determined using only the creep function plus the law of variation of the elasticity modulus with the concrete age. This analysis demonstrates that Carlson's process overestimates relaxation and that the relaxation function obtained by this process is not sufficient to preserve a strain equal to unity during the relaxation process. Application of Carlson's method demands that the creep phenomenon obeys the hypothesis used by Dischinger, which assumes parallelism of creep curves and which may not be valid. Two versions of the use of the integral equation which expresses the relaxation phenomenon are demonstrated. The first process determines the real value of relaxation through numerical solution of the integral equation. The second process, known as the average logarithm process, utilizes an alternative algorithm which leads to an entirely recurring expression. This second process results in a slight overestimation of relaxation, which diminishes as time elapses after application of the initial strain. (Carroll-FRC)
W82-05511

AN OVERVIEW OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ. Storm and Combined Sewer Section.
For primary bibliographic entry see Field 5D.
W82-05744

ALTERNATIVE TUNNELLING METHOD FOR RELIEF SEWER.
Civil Engineering (London), p 18, February, 1982. 1 Fig.

Descriptors: *Tunneling, *Pipelines, Unitunnel, Tunnel construction, Sewer systems, Structural settlement.

The Unitunnel system is being used to drive a sewer tunnel 280 m long and 1300 mm in diameter under and near streets and buildings in Acton, West London. The tunneling system operates like an earthworm. Frictional resistance controlled by automatically operated rubber bladders between each pipe section drives the system foward, producing a worm-like movement through the ground. When tunneling is finished, the bladders are inflated, then removed, leaving a gap which may be sealed. Work with the Unitunnel apparatus proceeds about 2.5 times faster than with a digging machine. A rate of 33 mm per min was achieved at less than full potential. No settlement was measured after the tunneling had passed under railroad tracks and within 6 ft of buildings. Only 3 mm settlement was measured in gardens where the tunneling apparatus had been operating at a depth of 10 ft. (Cassar-FRC)
W82-05774

WEDGE-BLOCK TUNNELS IN WATER SUPPLY,
Thames Water Authority, London, (England).
P. Cooley.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 9-26, 1982. 7 Fig, 5 Tab, 17 Ref.

Descriptors: *Tunnel linings, *Conduits, *Water supply, Water distribution, Tunnel construction, Concrete construction, Wedge block tunnels, Load distribution, Leakage, Clays, Pressure conduits, Water conveyance.

Experience in England with the wedge-block tunneling method is described in detail. This technique, first used in the 1950's, eliminates the steel lining. Concrete hoops with an open space are put in position, and a closing wedge is driven into the remaining opening. Average short-term (12 months) hoop loads were 45-67% of the overburden load. Specifications developed for constructing wedge-block tunnels are as follows: 2.54 m diameter, 140 mm ring thickness, depth of 30-57 m in London Clay, and ram thrusts of 35 tons for 0.61 m long rings and 40 tons for 0.69 m rings. Wedges have a taper of 1 in 10 at each side. Concrete molds are most suitable for casting segments. Leakage at shafts can occur, especially if the shaft is dry, because of inadequate grouting. Two wedge-block tunnels at the same level within 1-5 m of each other increased hoop loads by 7%, not enough to cause concern. (Cassar-FRC)
W82-05803

8G. Materials

A PIPELINE FOR ALL ENVIRONMENTS,
Stanton and Stavely, Nottingham (England).
T. R. Smith, and M. J. Sherwin.
Aqua, No 1, p 17-19, 1980.

Descriptors: *Pipes, *Iron, *Ductility, Pipelines, *Materials engineering, Environmental effects, Physical properties, *Water supply systems, Design standards.

Ductile iron pipe is capable of withstanding stresses imposed on it by climatic, topographical, geological and anthropogenic conditions. In ductile iron, which is four times stronger than grey iron, graphite is present in spheroidal form. The pipe can withstand hydraulic pressures higher than normal working pressures, a capability important where water must be moved long distances in mountainous terrain. It can tolerate very high external loadings, eliminating the need for special embedments. Pipes installed above ground need supports only every 12 meters. Excellent resistance to impact loading is important during handling and transport, excavations, water hammers, and surges. Ductile iron pipes are also fire and earthquake resistant. Flexible joints perform best in most locations-- soft ground, steep inclines, tunnels, riverbeds, and areas where excavations are common. These joints prevent damage by thermal expansion and contraction and by galvanic action. (Cassar-FRC)
W82-04764

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: PART 2, THEORETICAL CONSIDERATIONS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
M. R. Schock, and R. W. Buelow.
Journal of the American Water Works Association, Vol 73, No 12, p 636-651, December, 1981. 27 Fig, 11 Tab, 91 Ref.

Descriptors: *Asbestos cement, *Corrosion control, Water distribution, Pipes, Zinc compounds, Acidic water, coatings, solubility, Water quality, Calcium carbonate, *Pipelines, Chemistry precipitation, Rehabilitation.

Several conclusions were made in a study of the reaction of asbestos cement pipe with water containing various constituents. (1) The traditional agressiveness index based on calcite saturation is inadequate to describe the degradation of asbestos cement pipe. The presence of naturally-occurring protective materials, pH, carbonates, calcium, disinfectant concentrations, temperature, and organic matter must also be considered. (2) Some materials cause pipe matrix dissolution but do not necessarily release asbestos fibers. (3) The chloride, sulfate, and orthophosphate salts of zinc are satifactory corrosion inhibitors for asbestos cement pipe at the proper concentrations and pH. The mechanism involves formation of a zinc hydroxy carbonate precipitate which reacts with the pipe surface to form a harder zinc silicate coating. (4) Tthe Zn orthophosphate protects against corrosion in a metal-asbestos cement pipe system through the action of the orthophosphate rather than Zn. Zinc chloride and sulfate are not effective in these situations. (5) A degraded asbestos cement pipe with loose fibers cannot be readily rehabilitated by Zn treatment. (6) Results of Zn solubility modeling presented in this paper are also applicable to studies of new galvanized piping. (Cassar-FRC)
W82-04791

USE OF WATERTIGHT FILM FACINGS FOR REPAIR WORKS ON THE GREAT STAVROPOL CANAL,
Y. U. Baigorov, Y. M. Kosichenko, and B. I. Sergeev.
Hydrotechnical Construction, Vol 15, No 6, p 369-373, June, 1981. 5 Fig, 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 40-43, June, 1981.

Descriptors: *Seepage control, *Canal linings, Canal seepage, Polymers, Plastics, Maintenance, *Great Stavropol Canal, *USSR.

Seepage control measures at the Great Stavropol Canal in the North Caucasus were necessary because serious problems were observed during 1965-1979. Deformations, intense local seepage, threat of break-through, and rise in groundwater levels were caused by complex relief of the canal route, susceptibility of soils to subsidence and piping, absence of watertight facings, insufficient compaction of soil, and poor construction techniques. Small-scale installation of a soil-plastic film facing showed that the specific drainage flow in the section was reduced 17-30%. Installation of the soil-film facings involved stopping the streamflow in the construction area with cofferdams, excavating

a meter-thick soil layer, compacting the base, filling with high quality soil, laying butyl rubber film of 1.5 - 3 mm thickness, adding a protective layer of loam, and finishing with a protective gravel-rubble layer. (Cassar-FRC)
W82-05117

GALVANIZED STEEL STALLS TREATMENT PLANT CORROSION,
B. Harmon.
Water/Engineering and Management, Vol 129, No 2, p 42-43, February, 1982. 3 Fig.

Descriptors: *Wastewater facilities, *Corrosion, Zinc, *Galvanized steel, Construction, *Design criteria, Secondary wastewater treatment, Wastewater treatment, *Baltimore, Maryland.

The majority of the major structures and components of the Baltimore Back River Wastewater Treatment Plant have been virtually maintenance-free for over 30 years, largely due to the extensive use of hot dip galvanizing with zinc. The plant was constructed in 1911 and functions as a secondary treatment facility, occupying a 453 acre wooded site in eastern Baltimore County at the head of the Back River. Back River has three levels of treatment. The preliminary step includes bar screens and grit removal basins. Screening removes large floating objects which may clog or damage pipes, pumps or other devices. The grit removal basin is the next stage; here, the stream velocity is reduced and granular particles settle out. The wastewater is then conveyed to the primary tanks where smaller suspended organic particles settle in seven large sedimentation basins. About 30-50% of the suspended organic material normally settles and is removed as sludge. Secondary treatment is then accomplished by trickling filters and activated sludge. The sludge process uses aerobic microorganisms to feed on suspended organic material for growth and reproduction. Applications of the zinc-coated steel exposed to atmospheric corrosion are centered around the aeration process. Much of the structural steel, especially at the water line, is galvanized, as are the scum and flow troughts in the final settling tanks. Galvanized steel is prepared by immersing a precleaned fabricated part or structure into a kettle of molten zinc at a temperature of about 850 degrees F. The steel remains in the zinc bath until its temperature rises to that of the zinc. As the object is removed, a protective coating of zinc is bonded to the steel. (Baker-FRC)
W82-05167

THE BOOMING BUSINESS IN WICK DRAINS,
A. Morrison.
Civil Engineering (New York), Vol 53, No 3, p 47-51, March, 1982. 1 Fig.

Descriptors: *Drainage, *Dewatering, *Wick drains, Soil consolidation, Sand, Permeability.

Wick drains, introduced into the U.S. in 1978, have been replacing sand drains for soil consolidation. The Kjellman wick, invented before World War II in Sweden, consisted of three layers of cardboard, the inner one containing ten channels. Modern wick drains have many more channels than the original invention. Polyester or paper filters offer high permeability, wet strength, and shear resistance. Installation to 100 ft is possible. Most can be installed using a conventional vibrating hammer with a wick installation rig. Prices range from $0.70 to $1.20 per foot of drain installed compared to $3.50 to $6.50 per foot of sand drains. Five suppliers serve the U.S. with different types of products--paper or polyester filters, different permeabilities, and different drain capacities. Installation methods must consider the sensitivity of the soil. Suppliers and literature on wick drains are listed. (Cassar-FRC)
W82-05192

CASE STUDY OF PREDICTION OF SULFIDE GENERATION AND CORROSION IN SEWERS,
Brown and Caldwell, Sacramento, CA.
W. J. Meyer.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2666-2674, November, 1980. 3 Fig, 6 Tab, 5 Ref.

Descriptors: *Sulfides, *Corrosion, *Liners, Pipes, Concrete, Construction materials, Corrosion control, Wastewater treatment, *Sewer systems, Design criteria, Construction, *Case studies, *Sacramento, California.

A case study was performed to compare the results predicted by sulfide generation and corrosion equations with observed conditions in the Central Trunk sewers located in Sacramento County, California. Data have been accumulated on this trunk system by the county since the trunk was placed into operation in 1962. The Central Trunk serves the southeastern portion of the Sacramento metropolitan area. The sewer conveys both domestic and industrial wastewater from its tributary area and solids from the Northeast and Cordova wastewater treatment plants. No correlation was found between the measured and predicted sulfides using Thistlethwayte's equations. These equations result in sulfide predictions which are much higher than those observed. The sulfide buildup predicted by Pomeroy's equations assuming a less-conservative coefficient for sulfide losses of 0.96 correlates well with measured sulfide concentrations. The change in sulfide conditions occurring at major junctions should be considered when the characteristics of the wastewater in the tributary sewers vary significantly from the wastewater characteristic in the primary interceptor. Use of the Pomeroy equations for predicting sulfide generation and resultant corrosion provides a useful tool in the design of sewers. The designer has several options to assure an adequate service life: using acid-resistant materials, providing oxygen or other oxidant to the wastewater, adding chemical control of sulfide generation, providing sacrificial concrete covers over the reinforcing steel and/or using calcareous aggregate, using protective liners on the pipe and structures, or designing system hydraulics to avoid sulfide generation. (Baker-FRC)
W82-05267

GUIDEVANE EROSION AT MAO TIAO HE,
L. Xue-Zhong.
International Water Power and Dam Construction, Vol 34, No 2, p 23-26, February, 1982. 4 Fig.

Descriptors: *Powerplants, *Corrosion, Mao Tiao He river, China, Design criteria, Abrasion, Sand, Turbines, Cavitation, Pumps.

Unusual and severe wear erosion was experienced by the guidevanes of Unit II at the Fourth Stage power station on the Mao Tiao He river in China. The powerhouse of the station contains three Francis turbines operating under a net head of 53-65 meters and a draft head of -3.5 meters. Unit II went into operation in September of 1971. In March 1973 severe wear erosion caused by sand in the flow was found on all of the guidevanes. No similar damage was noted on the surfaces of other parts such as the spiral case, the stayvane and the runner. During the station's operation, Units II and III had each worked about 5000 hr, including about 500 hr of operation as condensers. The upper part of the inside of the casing of all guidevanes had suffered severe wear, affecting between a third and half of the inside area in the form of two wide, smooth horizontal grooves. No typical trace of cavitation erosion was noted in the wear area. The wear erosion only appeared on the upper part of the inside of the guidevanes. In Unit III under similar operating conditions, no such wear was found. The problem could not be traced to turbine wear through sand flow, although the worn surfaces appeared to be features of sand wear erosion. In studies of the water movement, the wearing was traced to the water in the runner chamber not being under pressure and the runner turning under the water during this operating condition. When a turbine operates as a pump, when idling, the sand carried by the water in the draft tube gradually accumulates in the corner formed by the protective plate and the upper part of the inside of the guidevanes. A circular space is created where the sand concentration increases according to the operating time, causing severe wear on the guidevanes. (Baker-FRC)
W82-05600

LOAD FACTORS AND NON-DESTRUCTIVE TESTING OF CLAY PIPE,
National Clay Pipe Inst., Crystal Lake, IL.
E. J. Sikora.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2964-2976, December, 1980. 16 Fig, 1 Tab.

Descriptors: *Sewer systems, *Load factors, *Pipes, Nondestructive tests, Clay pipe, Bedding materials, Backfill, Trenches, Sand, Compaction, Soil compaction, Gravel, Flooding, Materials testing.

Nondestructive tests were conducted to determine the validity of load factors presently used in design of sewer systems with vitrified clay pipe. The current load factors for Classes B, C, and D bedding systems were found valid when stable bedding materials were used. The best all around choice of bedding material is a 19.2-6.3 mm gradation. Bedding materials of sizes 6,7, and 8 and combinations thereof are all capable of developing the required load factors. The load factor and quality of installation in Class B (except for sand) and Classes C and D are improved by shovel-slicing the bedding material under the pipe haunches. Stability of a bedding material increases with increasing particle size, but mixtures with particles larger than 19 mm are difficult to shovel-slice. Angular, well graded bedding materials are desirable in trenches with irregular bottoms or with difficult-to-maintain widths and in all Class B installations. Use of rounded bedding material is permissible in narrow trenches where bedding is confined. Although sand has performed well as a bedding material in all-sand regions (deltas and coastal areas) it should not be imported for this use because of its variable performance, especially under flooding conditions. (Cassar-FRC)
W82-05700

MEASURING RESERVOIR GROUND MOVEMENTS,
Nottingham Univ. (England).
V. Ashkenazi, A. H. Dodson, D. E. B. Jones, and N. Samson.
Civil Engineering (London), p 35,37,39, 41-43, February, 1982. 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Reservoirs, *Surveying instruments, *Dam stability, Thames Water Authority, Queen Mother Reservoir, Dachet, *England, Embankments, Earthworks, Subsidence, Networks, Network design.

A geodetic surface reference system installed at the Queen Mother Reservoir, Dachet, England, accurately measured horizontal and vertical surface movements. The network consisted of 10 station pillars on the downstream crest, two remote pillars, a 700 m distant benchmark, and 64 detail points around the toe of the embankment. Angles were measured with a Wild T2 theodolite and distances with a Wild D 13S Distomat. Measurements over a 2-year period indicated that the embankment crest moved 15 mm outward and 12 mm downward during this time. (Cassar-FRC)
W82-05773

8H. Rapid Excavation

TUNNELLING MACHINE SAVES TIME AND MONEY,
International Water Power and Dam Construction, Vol 33, No 12, p 47-49, December, 1981. 1 Fig, 2 Tab.

Descriptors: *Water conveyance, *Tunneling, *Construction equipment, Rapid excavation, Mountains, Austria, Rock excavation.

An Atlas Copco Jarva tunnel boring machine is being used in the construction of the Wolla water tunnel in Karnten, Austria. The tunnel, which will

be 6.7 kilometers long and 3.5 meters in diameter, is part of a large hydroelecric complex in Karnten. Ten 11 hour shifts were required for assembly of the machine at the tunnel entrance. Atlas Copco provided two specialists during assembly, two for training, and one throughout the tunneling period. Conventional drill and blast procedures were used to excavate the first 135 meters of the tunnel, since this section was too narrow for the machine to bore and the rock was not suitable. The machine is generally able to work its way through the alpine gneiss and mica schists at an average rate of about 32.7 meters per 22-hour day. The tunnel boring machine is equipped with a roof shield for protection from falling rock, but the removal process required when overbreak falls below and beneath the machine is time-consuming. The cutters, also manufactured by Atlas Copco, usually last for bout 25 meters of tunnel. Use of the tunnel boring machine is resulting in savings of up to 50% in time and labor, 50% in energy, and 10% in costs in comparison with the estimated costs associated with using conventional drill and blast methods to create this tunnel. The tunnel boring machine also produces a smooth surface and regular shape. (Carroll-FRC)
W82-05513

EXPERIENCE IN PREPARING THE ROCK FOUNDATION OF THE DNESTR HYDROELECTRIC STATION,
A. E. Azarkovich, M. I. Shuifer, A. I. Tsvetkov, S. S. Gandzyuk, and E. L. Budnikov.
Hydrotechnical Construction, Vol 15, No 8, p 459-461, 1981. 1 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 21-22, August, 1981.

Descriptors: *Explosives, *Foundation rocks, *Excavation, Blasting, Rock foundations, Dam foundations, Hydroelectric plants, Drilling, Dnestr Hydroelectric Station.

The Dnestr hydrostation foundation was prepared without jackhammer drilling at a labor reduction of 0.33 man days per sq m of foundation. Formerly, cracks in the rock foundations were avoided by removing the last rock layer in the following manner: a 4-5 m layer was removed by firing 0.11 m diameter long-hole charges in a close pattern, the next 1 m loosened by 1 m short-hole charges to a depth of 0.6 m, and the remaining 0.4 m removed manually by picks and wedges. The new scheme used long-hole charges of 0.15 m diameter arranged in the normal pattern for the upper 3-4 m layer. The lower 2 m was loosened by close spaced long-hole charges of the calculated diameter (in this case 0.085 m) in 0.11 m diameter boreholes. Little manual excavation was required after loosening rocks in this manner. Testing showed that the rock foundation quality was within specifications. (Cassar-FRC)
W82-05585

DRIVING LARGE HYDRAULIC TUNNELS BY THE STEPPED FACE METHOD,
V. M. Mostkov.
Hydrotechnical Construction, Vol 15, No 8, p 496-502, 1981. 3 Fig, 2 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo. No 8, p 47-51, August, 1981.

Descriptors: *Tunneling, *Hydraulic structures, *Excavation, Tunnel construction, Stepped face method.

The stepped-face method for excavating tunnels of large cross section involves dividing the tunnel into two to four levels, each 4-7 m high, and excavating each level at a 30-50 m lag behind the next higher level. This produces a stepped face which allows trucks, bulldozers, and cranes to move up or down a 20-25 degree blasted rock slope. Blasting and excavation proceed simultaneously on each step. This method is suitable for tunnels more than 10 m high in comparatively homogeneous rocks. The tunnel roof and walls are supported on each level by anchors and shotcrete. Concreting is done with a lag behind digging or after completion. A typical three-level tunnel will advance 2.5-3.5 m per day, about 1.5 times faster than with the lower bench method. (Cassar-FRC)
W82-05586

QUALITY OF CONTOURING WORKINGS WHEN DRIVING UNDERGROUND STRUCTURES AT THE NUREK HYDROSTATION,
M. D. Bondarenko.
Hydrotechnical Construction, Vol 15, No 8, p 453-458, 1981. 3 Fig, 5 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 17-20, August, 1981.

Descriptors: *Underground structures, *Tunnel construction, *Rock excavation, Tunneling, Tunnel linings, Quality control, Excavation, Blasting.

Graphs were prepared to determine the average linear overbreak of tunnels under construction for comparison with standards or regulations. Two graphs were constructed: one as a function of the specific perimeter of the tunnel and overbreak coefficient and the other as a function of the thickness of the concrete lining and overplacement coefficient. These were applied to an analysis of the quality of tunneling at the Nurek hydrostation, USSR. Average linear overbreak was 0.46 m, of which overbreak due to boring accounted for 0.22 m and overbreak due to geological factors accounted for 0.24 m. Tunneling quality is affected by two main factors: boring and blasting methods and structural geology of the rock mass. (Cassar-FRC)
W82-05590

8I. Fisheries Engineering

ENGINEERING ASPECTS OF FISH PROTECTION AT WATER INTAKES,
B. S. Malevanchik.
Hydrotechnical Construction, Vol 15, No 6, p 374-381, June, 1981. 6 Fig, 1 Tab, 9 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 6, p 44-48, June, 1981.

Descriptors: *Fish guiding, *Protection, *Intakes, Fish barriers, Fish conservation, Diversion structures, Hydroelectric plants, Reservoirs, Headrace, Screens, Meanders, Canals, Fish eggs.

Three methods of protecting fish from entering water intakes of large hydroelectric installations are presently under research in the Soviet Union. Fish barriers, which retain the eggs and young fry on screens or shields, are labor intensive and not too effective in protecting fish at a large intake. Fish-enclosing methods withdraw intake water from boom-enclosed areas outside of fish habitats. During migration the water intake can be stopped or reduced to a safe level. However, enclosures are only effective when the fish distribution (diurnal and seasonal, vertical and horizontal) has been thoroughly documented for the individual water body. Fish diverting methods concentrate the drifting fry population into a narrow band along one of the stream banks and divert the flow into an area unaffected by the water intake. Studies of fish in meandering streams and in test flumes show that the fish movement obeys the laws of fluid motion. Maximum concentration of fry is near the concave bank of the stream where the transverse velocity component changes direction from the concave to the convex bank. A 7 degree bottom slope toward the concave bank intensifies the fish-concentrating effect. A curved headrace is of canal curvature/canal width of 3 to 5 and a 7-10 degree slope toward the convex bank. The second most important element is a fish diversion structure one third to one fifth the depth of water in the canal. Optimum water velocity in the headworks is 1.2-1.5 times greater than in the headrace. (Cassar-FRC)
W82-04759

HYPOLIMNION OXYGENATION STUDIES IN CLARK HILL LAKE,
Drexel Univ., Philadelphia, PA.
For primary bibliographic entry see Field 5G.
W82-05001

PREDICTIVE MODELS OF BENTHIC MACROINVERTEBRATE DENSITY FOR USE IN INSTREAM FLOW STUDIES AND REGULATED FLOW MANAGEMENT,
Wyoming Univ., Laramie. Water Resources Research Inst.
J. A. Gore, and R. D. Judy, Jr.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1363-1370, November, 1981. 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Stream fisheries, *Mathematical models, *Population density, *Macroinvertebrates, Prediction, Benthic fauna, Instream flow, *Regulated flow, Flow control, Aquatic insects, Mathematical equations, Computer models, Simulation analysis, Fish food, Water management.

If a streamflow management strategy is to assure optimum fish production, it must include a flow to maintain invertebrates, which are often the primary source of food for fish. The U.S. Fish and Wildlife Service, Cooperative Instream Flow Service Group, has developed the PHABSIM model, an incremental method for the determination of habitat suitability for sport fish species at various discharge levels. A similar method for determining optimum conditions for stream macroinvertebrates is proposed as an adjunct to the Fish and Wildlife Service model. This proposed method stresses predictions of density maxima and flow predictions for maintenance of suitable lotic habitat. The PHABSIM model was used to determine velocity, depth, and substrate preferenda for 19 aquatic invertebrates. The curve-fitting equations of the PHABSIM computer simulation showed high reliability in predicting physical habitat tolerance of selected aquatic insects. An example using Nectopsyche lahontonensis is presented. The new predictive model, which utilizes exponential polynominal analysis, provides a 'fine-tuning' function to allow a narrower confidence limit on regulated flow recommendations. This model also responds to criticisms of earlier models which do not include the dependence of velocity and depth in stream channel hydraulics. The added cross-product term in the model alters the predicted peak responses (density) with random changes in depth and velocity. The effectiveness of this model in stream management has not yet been tested. (Carroll-FRC)
W82-05194

PLACER MINING AND SALMON SPAWNING IN AMERICAN RIVER BASIN, CALIFORNIA,
Bureau of Reclamation, Sacramento, CA.
N. P. Prokopovich, and K. A. Nitzberg.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 67-76, 1982. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Spawning, Aquatic habitats, Stream beds, *American River, *California, *Salmon, Fish, *Mine wastes, *Dredging, Tailings, Spoil banks, Gravel, Gold, Channel improvement, Geology, Petrography, Alluvial deposits, *Water pollution effects.

The American River, near Sacramento, California, was apparently improved as a salmon spawning stream as the result of gold mine dredging operations. A 70 sq km tailing area, one of the largest in the state, is located on this river. Gold dredges appeared in California in the 1900's, and draglines were introduced in the 1930's. 1308 pebbles in 12 gravel-rich sites favorable for salmon spawning were examined by hand lens and classified into four groups: metamorphic, granitic, volcanic, and quartz. At five sites the pebble composition reflected the composition expected from upstream rocks. At five other sites the gravel composition was similar to that of the dredge tailings rather than the average composition of the water-shed or the average composition of rocks in the main and tributary canyons. Although no reliable data on pre- and post-dredging spawning conditions in the American River are available, some scientists feel that present-day spawning conditions are better than in pre-dredge times. (Cassar-FRC)
W82-05200

FISHERY IMPORTANCE OF THE URAL-CASPIAN FISHING DISTRICT AND PROBLEMS OF ITS WATER SUPPLY,
A. P. Musatov, and Y. N. Podushko.
Water Resources, Vol 8, No 2, p 132-135, March-April, 1981. 5 Ref. Translated from Vodnye Resursy, No 2, p 72-76, March-April, 1981.

Descriptors: *Fisheries, *Water management, *Water transfer, Sturgeon, Caspian Sea, *Ural River, Volga River, Canals, Spawning, Reservoirs, Lake Chelkar, Water resources development, Runoff, *USSR.

The effect of water management of the Ural River on sturgeon spawning is discussed. Sufficient flooding of the spawning grounds (total of 1700 ha) occurs when spring runoff exceeds 5 cu km per year. If the region between the Ural and the Volga is developed for grain farming and animal husbandry, water consumption will increase. This will produce annual runoffs less than 5 cu km in 17 to 30 years. Of these 17 years, 11 will have flows less than 3 cu km. During 1936-66 annual runoff was less than 5 cu km only six times. The authors believe that the discharge volume of the Ural can be maintained at amounts optimal for fish reproduction only by delivering Volga water to the Ural. A planned 425 km canal can supply enough water to meet fishery requirements. The necessary increase in regulating storage could be provided by using Lake Chelkar on the Ural banks to receive water from the proposed canal and deliver it to the Ural via the Solyanka River. An increase of 5 m in embankment height would provide a total of 2.5 cu km storage. This would permit annual Ural runoff of 75% and 50% probabilities of 7 and 10 cu km, annual runoff, respectively, assuring optimal conditions for reproduction and foraging of sturgeons and semimigratory fish in the eastern part of North Caspian Sea. (Cassar-FRC)
W82-05342

RESOLVING THE FISH VS FLOOD CONTROL CONTROVERSY ON THE VEDDER RIVER,
For primary bibliographic entry see Field 4A.
W82-05765

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

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Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 6B.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 12
DECEMBER 1, 1982

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 12
DECEMBER 1, 1982

W82-05901 -- W82-07000

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,
Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
C. L. Feldman, R. P. Kokernak, R. Lisauskas, and S. Nydick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243346, Price codes: A05 in paper copy, A01 in microfiche. Final Report 1981. 72 p, 23 Fig, 47 Ref. OWRT (1165/No 2736)(1).

Descriptors: *Compressible flow, *Kinetics, *Multiphase flow, *Model studies, *Sound waves, Compressibility, Fluid flow, Friction, Fluid mechanics, Hydraulics, Hydrodynamics, Mathematical studies, Model testing, Linear programming, Experimental design, Experimental data, Theoretical analysis, Acoustics, Mechanical engineering.

A linearized model for transmission of a plane wave through a single component two-phase bubbly mixture was developed. Data from assessment of the compressibility of a single bubble under a pressure pulse were used in a scattering model to predict the speed of sound, and resulting in the determination of the speed of sound as a function of frequency. The results clearly demonstrate the effects of phase change and heat transfer at low frequencies with resonance and cut-off at higher frequencies. The experimental model generated speed of sound measurement by passing an acoustic tone-burst through the medium and measuring transit time (directly or as a phase lag), using a mixture created by passing saturated vapor through a porous metal filter and allowing the bubbles to rise in a saturated liquid. A partially successful attempt was made to measure the vapor fraction at the level of the acoustic transducers with a differential pressure measurement using both water and Refrigerant-12; qualittive verification was possible, with some quantitative discrepancies in the resonant frequency. Application of the sound speed model to flow in two-phase devices was also studied; various critical two-phase flow theories were examined and a model for predicting weak shock thickness was developed. This model was compared with recent experimental reports on pressure waves in boiling water. (Zielinski-MAXIMA)
W82-05910

2. WATER CYCLE

2A. General

COMBINING SITE-SPECIFIC AND REGIONAL INFORMATION: AN EMPIRICAL BAYES APPROACH,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 306-314, April, 1982. 4 Fig, 5 Tab, 20 Ref.

Descriptors: *Hydrologic models, *Probability distribution, *River basins, *Flood frequency, Data interpretation, Model studies, Mathematical models, Basins, Flood forecasting, Flood peak, Regional analysis, Frequency analysis.

The empirical Bayes theory, adapted to a hydrologic context, was used to develop a format for making inferences about unmonitored river basin sites by combining site-specific and regional data. Information from similar basins is used to improve upon inferences at a particular basin. The superpopulation concept of the Bayesian approach uses a probability distribution to randomly assign basin parameters. This concept closely resembles regionalization models and is inferred from observable regional data. The superpopulation distribution expresses the degree of similarity between two basins and treats regionalized estimators as a special case using procedures similar to James-Stein estimators. The method of moments approach which is used to infer the superpopulation is described. Although the empirical Bayes approach can have definite advantages over site-specific procedures, the latter offer better performance for basins which are very different from the majority. The empirical Bayes procedure was applied to two examples of food frequency analysis. (Geiger-FRC)
W82-05903

TOPOLOGIC MODEL FOR DRAINAGE NETWORKS WITH LAKES,
Univerity of Western Ontario, London. Dept. of Geography.
D. M. Mark, and M. F. Goodchild.
Water Resources Research, Vol 18, No 2, p 275-280, April, 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Networks, *Open-channel drainage, *Drainage, *Glacial lakes, Model studies, Channel inflow, Channels, Mathematical models, Catchment areas.

Although R. L. Shreve's probabilistic-topologic model for channel networks is successful at predicting many of the overall properties of drainage networks and drainage basins, it cannot be directly applied to networks containing lakes fed by multiple inlets. An extension of Shreve's model is presented in which networks can be represented by integer strings directly analogous to the binary strings used for trivalent channel networks without lakes. The validity limitations on integer strings are presented, along with combinatorial results and techniques for generating topologically random networks. In the case of a 596-link network in northern Ontario, when it is assumed that network element degree and type are independent of position within the integer string, good predictions of the relative frequencies of various classes of small subnetworks are obtained. When the number of lakes in the network equals zero, the model collapses to Shreve's. (Geiger-FRC)
W82-05905

LAG TIME FOR DIVERGING OVERLAND FLOW,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and N. Agiralioglu.
Nordic Hydrology, Vol 13, No 1, p 39-48, 1982. 6 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Kinematic wave theory, *Flow friction, *Overland flow, *Rainfall-runoff relationships, *Watersheds, Darcy-Weisbach equation, Chezy equation, Friction, Mannings equation, Surface runoff, Surface water, Mathematical equations.

Analytical and nomographic solutions were developed for the surface water lag time for diverging overland flow using kinematic wave theory. These solutions show that lag time for a given watershed is not constant but changes with rainfall characteristics. In order to utilize these solutions, some knowledge of the geometric parametes and friction characteristics of the watershed under study is required. Uses of the Chezy equation, Manning equation, and Darcy-Weisbach relations for friction in the calculation of lag time are presented. (Geiger-FRC)
W82-05944

ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,
Binnie and Partners, London (England).
J. Wild, and J. K. Hall.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 85-108, March, 1982. 15 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrology surveys, Developing countries, North Sumatra, *Indonesia, Rainfall, Runoff, Water quality, Oil erosion, Networks, Gaging stations, *Data collections, Groundwater, Streamflow, Evaporation, Sediment.

Results of an extensive hydrologic survey (1976-80) in North Sumatra, Indonesia, are described. The province has a considerable number of hydrometeorological stations for a developing country--85 river gages, 20 climatologic stations, and 500 rain gages for a 71,000 sq km area. However, there are gaps in data because of operating and administrative problems. Gaging equipment is concentrated in the eastern coastal area and sparse in the central highlands. Little data are available for 1941-early 1950's. In North Sumatra rainfall is influenced by the monsoon systems of southeast Asia and Australia, the equatorial double rainy seasons, and local orographic influences. Mean annual rainfall varies from 2000 mm on the east coast to 4000 mm on the western slopes of the Bukit Barisan. Nevertheless, in low rainfall regions irrigation is required for all crops from May to August and throughtout the year for bunded rice. Mean annual runoff is 900 mm to over 2000 mm. The short period off records requires that conservative growth factors be used in estimating design floods. The little available information on water quality and sediment indicates that there are high levels off bacterial pollution , and waterborne diseases are endemic. Water is satisfactory for irrigation except in some volcanic areas (hot and sulfurous) and swampy regions (acid). Soil erosion is a major problem, with average denudation rates oof 1-10 mm per year. About 250,000 groundwater wells supply 80-90% of rural water. Springs are numerous, and groundwater potential greatly exceeds demand in most regions. Some large projects are in progress--two hydroelectric stations, hydrologic surveys off the Sei Deli/Belaway estuary, water supply schemes, flood control, and irrigation. (Cassar-FRC)
W82-05949

AN EVALUATION OF FLOOD FREQUENCY ESTIMATES BASED ON RAINFALL/RUNOFF MODELING,
Geological Survey, Reston, VA.
W. O. Thomas, Jr.
Water Resources Bulletin, Vol 18, No 2, p 221-230, April, 1982. 2 Fig, 8 Tab, 12 Ref.

Descriptors: *Flood frequency, *Rainfall-runoff relationships, *Flood forecasting, Runoff, Streamflow forecasting, Model studies, Hydrologic models, Flood discharge, Flood recurrence interval.

Flood frequency estimates obtained from a rainfall-runoff model by Dawdy, et al. (1972) were evaluated by two methods: (1) partition of variance method by Lichty and Liscum (1978), a computation of the equivalent years of record for regional estimating equations based on 50 small stream sites in Oklahoma, and (2) the prediction variance method developed in this paper, a computation of the bias for synthetic flood estimates as compared to observed estimates at 97 small stream sites in eight eastern states with at least 20 years of record. Method 2 was more appropriate than Method 1 because it was not as dependent on as many assumptions as Method 1. The Dawdy model tended to underestimate extreme flood discharges based on observed record (11-29% less than observed values for a 100-year flood discharge). Since synthetic flood frequency curves based on rainfall/runoff models are highly correlated, little or no regional (spatial) information can be added to the network. The equivalent years of record for the regional estimating equation based totally on synthetic flood discharge was considerably less than the length of rainfall record used to simulate the runoff. The degree of correlation between observed and synthetic flood frequency estimates at the same site appeared to vary with recurrence interval. (Cassar-FRC)
W82-06068

WATER RESOURCES OF THE OCHLOCKONEE RIVER AREA, NORTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. A. Pascale, and J. R. Wagner.
Geological Survey Open-File Report 81-1121 (WRI), 1982. 114 p, 35 Fig, 16 Tab, 43 Ref.

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Field 2—WATER CYCLE

Group 2A—General

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Data collections, Geohydrology, Rainfall-runoff relationships, Water supply, Aquifers, Groundwater movement, Aquifer characteristics, Wells, Water yield, Potentiometric level, Drawdown, Saline water, Streamflow, Flow characteristics, Chemical analysis, *Florida, Ochlockonee River basin, Floridan aquifer.

The Ochlockonee River area, in the northwest Florida panhandle, receives an average of 57 inches of rainfall per year. Water use in 1975 averaged 11.4 million gallons per day. Much of the rainfall that is not lost to evaporation enters the surficial sand aquifer, seeps to streams, or enters the water-bearing zone of the upper confining unit above the Floridan aquifer. The water-bearing zone of the upper confining unit is important for rural domestic supplies, storage of water and recharge to the Floridan aquifer. The Floridan aquifer underlies all the area and is the principal source of municipal supplies. The potentiometric surface of the upper part of the Floridan aquifer ranges from about 50 feet higher than that of the middle and lower part of the aquifer in southwestern Gadsden County to about 10 feet higher in southeastern Gadsden County. Saline water occurs naturally at relatively shallow depths within the Floridan aquifer. Stream discharge is about 1,000 million gallons per day; minimum discharge is about 285 million gallons per day. The chemical quality of most streams in the study area is acceptable for most uses. (USGS)
W82-06132

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,
Universidad Simon Bolivar, Caracas (Venequela)> Graduate Program in Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W82-06199

A DISCRETE SYSTEM STORAGE MODEL FOR ANALYZING RAINFALL-RUNOFF RELATIONSHIPS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Transactions of the ASAE, Vol 25, No 2, p 362-366, 371, 1982. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Agricultural watersheds, *Hydrographs, *Storage equation, *Rainfall-runoff relationships, Model studies, Rainfall intensity, Runoff rates, Flood peak, Excess rainfall, Storms, *Illinois, *Unit hydrographs.

A unit hydrograph method and a discrete system storage model, derived from a generalized system storage relationship proposed by Chow and Kulandaiswamy (1971), were used to quantify the quasi-linear effects of rainfall-runoff relationships for small agricultural watersheds. The two watersheds near Monticello, Illinois, were less than 40 ha in size with silt loam soils and slopes up to 8%. The unit hydrographs from 30 storms varied with the storm characteristics when the ratios of peak discharge to total runoff were less than unity. Use of a discrete system storage model showed that 6 hydrologic variables of rainfall intensity and runoff rates were necessary to explain system storage relationships. Simulations of storms by both methods produced peak discharges in good agreement with observed results. Neither method accurately simulated double peaks. (Cassar-FRC)
W82-06219

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06323

ACID RAIN MODEL: HYDROLOGY MODULE,
Tetra Tech. Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W82-06360

ADVANCED CALIBRATION METHODOLOGY FOR HYDROLOGIC RAINFALL - RUNOFF SIMULATION MODELS,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, V. K. Gupta, J. L. Fulton, and F. Arfi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256603, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No LSSPA-81-6, December, 1981. 146 p, 25 Fig, 15 Tab, 59 Ref, 2 Append. OWRT B-081-OHIO and C-90320-G(9442)(2). 14-34-0001-9442.

Descriptors: *Simulation analysis, *Rainfall-runoff relationships, *Mathematical models, *Stochastic hydrology, *Surface runoff, Mathematical studies, Least squares method, Model studies, Stochastic process, Probabilistic process, Streamflow, Computer models, Watersheds, Rainfall intensity, Rainfall index, Rainfall rate, Runoff, Runoff coefficient.

Stochastic estimation techniques are presented which are capable of improving hydrologic conceptual rainfall-runoff model calibrations by accounting for streamflow measurement uncertainties (and other, additive, errors). Specifically, the autocorrelated and the heteroscedastic (changing variance) error cases are considered. The methods are shown to perform well in simulation studies, and application of the techniques to the calibration of the U.S. National Weather Services soil moisture accounting model showed superiority of the new procedures over the commonly-used simple least squares criterion. The procedures were compared under different data conditions and starting parameter values. Results indicate important phenomena needing study and accountability. Its consideration gave more consistent and conceptually-realistic parameter sets, independent of starting value and/or data characteristics. However, despite these improvements, a unique parameter set for the watershed under study was not obtained. Probable reasons for this are given. Sensitivity measures capable of aiding examination of the criterion response surface in the region of the optimum are also discussed, and their applicability demonstrated. (Zielinski-MAXIMA)
W82-06366

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,
New South Wales Univ., Kensington (Australia). School of Geography.
F. C. Bell, and P. C. Vorst.
Australian Water Resources Council, Camberra, Technical Paper No 58, 1981. 131 p, 18 Fig, 13 Tab, 83 Ref, 2 Append.

Descriptors: *Hydrologic models, *Model studies, *Parametric hydrology, *Geomorphology, *Catchment basins, Hydrologic properties, Hydrologic budget, Hydrologic aspects, Hydrologic equation, Hydrologic data, Basins, Stochastic hydrology, Mathematical models, Mathematical studies, Model testing, Surveys, Data acquisition, Channel flow.

Geomorphic parameter types most relevant to the Australian Representative Basins program were investigated, along with their likely applications in hydrologic problems. Some emphasis is placed on stream channel parameters and field information for use in deterministic modeling of hydrologic processes; attention is also given to efficient surveying techniques and the serious problems of sampling and inference caused by the high spatial variability of parameters in most basins. A developed scheme for field measurements and data presentation is delineated which was exemplified and tested in 3 Basins having contrasting characteristics. Several other Basins were briefly studied to ensure inclusion of a wide range of catchment conditions. An examination of possible applications of the data in hydrologic modeling showed that measured channel parameters can be used for satisfactory estimates of the Laurenson Runoff Routing Model constants. Further study of the physical relationships between measurable catchment attributes and model constants is needed, which should be enhanced by application of the recommended scheme for geomorphic surveying and data presentation to as many basins as practicable. (Zielinski-MAXIMA)
W82-06384

COMPARING URBAN RUNOFF MODELS,
V. P. Singh.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division Vol 61, No 2, p 53-59, February, 1981. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Hydrographs, *Urban runoff, *Model studies, Urban watersheds, Statistics, Oakdale, Chicago, Illinois, Calvin Park, Kingston, Ontario, Computers, Rainfall-runoff relationships, Hydrologic models, Runoff, Urban hydrology, Storm water.

Three urban runoff models were compared with data on two urban watersheds, Oakdale in Chicago, Illinois (5.42 ha of residential area, 45.8% impervious) and Calvin Park in Kingston, Ontario (36.2 ha of residential area, 27% impervious). The runoff models were the Road Research Laboratory Model (RRLM), the University of Cincinnati Urban Runoff Model (CURM), and the EPA Storm Water Management Model (SWMM). Using the hydrograph peak and its time for evolution showed that no one model was uniformly better than another. For hydrograph peak time estimates, RRLM was better than SWMM and CURM on both watersheds. For hydrograph peak estimation SWMM was better than CURM and RRLM on Oakdale wateshed; RRLM was better than SWMM and CURM on Calvin Park watershed. Therefore, the choice of a model depends on the criterion of comparison and the watershed in question. (Cassar-FRC)
W82-06447

ANTECEDENT MOISTURE CONDITION PROBABILITIES,
Purdue Univ., Lafayette, IN. Dept. of Hydromechanics.
D. D. Gray, P. G. Katz, S. M. Demonsabert, and N. P. Cogo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 107-114, June, 1982. 5 Tab, 16 Ref.

Descriptors: *Antecedent moisture, *Probability distribution, Model studies, Precipitation, Rainfall-runoff relationships, Hydrologic models, *Indiana, *Kentucky, Tennessee, Runoff forecasting.

Growing season Antecedent Moisture Condition (AMC) probability estimates are presented for 17 locations in Kentucky, Tennessee, and Indiana. They refer to the AMC classes used in the runoff models, Soil Conservation Service (SCS) Runoff Equation (curve number method) and the Illinois Urban Drainage Area Simulator (ILLUDAS). The three SCS Classes are I, II, and III, described as lowest, average, and highest runoff potential, respectively, with < 1.4, 1.4-2.1, and > 2.1 inches of 5-day antecedent rainfall, respectively, in the growing season. The four ILLUDAS classes range from bone dry to saturated with 5-day antecedent rainfall of $0 > 1$ inches. The locations studied had a mean of 84.8% in the SCS Class I and a more even distribution of the ILLUDAS classes, 27.3%, 37.8%, 16.6%, and 23.6% in Classes I through IV, respectively. Equations are given for computing probability of occurrence of the AMC classes for other areas. (Cassar-FRC)
W82-06451

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, and E. L. White.
Water Resources Bulletin, Vol 18, No 1, p 95-98, February, 1982. 3 Fig, 2 Tab, 6 Ref. OWRT-A049-PA.

Descriptors: *Unit hydrographs, *Disribution graphs, *Flood peaks, Flood hydrographs, Flood discharge.

Synthetic unit hydrographs, which are used to estimate flood peak and volume for ungaged watersheds, should be easy to construct without a major watershed data collection effort, should have a smooth and single valued shape, and should contain a runoff volume equal to one unit (inch, centimeter, or millimeter) of rainfall excess. Most of the methods for generating these artificial unit hydrographs involve hand fitting a curve over a few selected points on the unit hydrograph. This task may be subjective and, in addition, the user may neglect or find it difficult to adjust the generated unit graph to a runoff value of one unit. A simple method which can be used to fit a smooth gamma distribution over a single point specified by the unit hydrograph peak and the time to peak with a guaranteed unit depth of runoff is demonstrated. The two values used can be determined by conventional synthetic hydrograph procedures. A comparison of this method with Snyder unit hydrographs indicated that the gamma distribution may tend to produce a somewhat broader crest than the Snyder graph, compensated by a steeper recession limb. An added advantage of the gamma distribution is that it can be convoluted analytically with several shapes of rainfall distributions. (Carroll-FRC)
W82-06586

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,
Z. N. Debrovol'skaya, G. P. Epikhov, P. P. Koryavov, and N. N. Moiseev.
Water Resources, Vol 8, No 3, p 226-241, May/June, 1981. 4 Fig, 25 Ref. Translated from Vodnye Resursy, No 3, p 33-51, May/June, 1981.

Descriptors: *Model studies, *Water quality, *Hydrodynamics, *Mathematical models, Flow, Prediction, Water management, Channel flow, Groundwater movement, Fate of pollutants, Boundary conditions, Lakes, Water Currents, Water circulation, Wind-driven currents, Numerical analysis, Hydraulics.

Results of recent work on mathematical modeling of the dynamics and quality of water are reviewed. Mathematical modeling at the Academy of Sciences of the USSR is aimed at creating a software system for automated design of water management problems. One-dimensional models of channel flow, the simplest mathematical models for studying unsteady flow in canals and river systems, are based on the classical system of St. Venant equations. The interaction of surface waters and groundwater of an arbitrary river basin may be modeled by adding the Boussinesq equations describing groundwater movement in a horizontal seepage approximation to the one-dimensional channel flow models. Two-dimensional models describe more complex hydrodynamic processes and can handle a broader class of applied problems. There are two types of such models: horizontal plane and vetical plane. Three-dimensional models can provide information on complex spatial movements in water bodies of an artibrary from under the effect of various physical factors. Examples of the model equations and sample problems are given. (Cassar-FRC)
W82-06613

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,
Maryland Univ., College Park. Dept. of Civil Engineering.
T. R. Bondelid, R. H. McCuen, and T. J. Jackson.
Water Resources Bulletin, Vol 18, No 1, p 111-116, February, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Mathematical models, *Sensitivity analysis, *Runoff coefficient, Error analysis, Remote sensing, Flood peak, Hydrologic models, Runoff volume, Pennsylvania.

The Soil Conservation Service (SCS) hydrologic models are being used increasingly for hydrologic design due to their relative accuracy, their flexibility, and their ability to use remotely sensed data. The primary input parameter for the SCS models is the runoff curve number, which is defined in terms of land use treatments, hydrologic condition, antecedent soil moisture, and soil type, permitting easy application of the models to ungaged watersheds. The accuracy of models using the runoff curve number for estimating design peak discharge and runoff volume is especially sensitive to the estimated curve number values. This study was designed to quantify in as straightforward a manner as possible the changes in runoff volume and peak discharge computations as a function of changes in curve number estimates. The hydrologic effects of curve number variation are evaluated in terms of the proportional changes in total runoff and peak discharge for a unit change in curve number. A series of curves is developed which demonstrates that the effects of variation in curve number decrease as design rainfall depth increases, such as for larger storm events. The value and use of these sensitivity curves are demonstrated using a comparison of Landsat and conventionally derived curve numbers for three watersheds in Pennsylvania. (Carroll-FRC)
W82-06631

HYDROLOGY OF SALT WELLS CREEK--A PLAINS STREAM IN SOUTHWESTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div.
H. W. Lowham, L. L. Delong, K. R. Collier, and E. A. Zimmerman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201211, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-62, April 1982. 52 p, 32 Fig, 2 Tab, 24 Ref.

Descriptors: *Small watersheds, *Hydrologic cycle, *Intermittent streams, *Geochemistry, Streamflow, Snowmelt, Storm runoff, Rainfall runoff relationships, Flushing, Salts, Sediment yield, Channel morphology, Aquatic environment, Energy, *Wyoming, Colorado River basin, Green River basin, Salt Wells Creek.

Development of energy minerals in plains areas of Wyoming is expanding rapidly. Such development may affect water resources and hydrologic relations of the plains; however, little information exists concerning hydrologic processes for these areas. This report summarizes results of a hydrologic study made during 1975-78 of Salt Wells creek, a drainage area of about 500 square miles located southeast of Rock Springs, Wyoming. The area is typical of arid and semiarid plains areas in southwestern Wyoming where mineral development is occurring. Salt Wells Creek is predominately an intermittent stream. Numerous springs in the headwaters cause small perennial flows in some upstream tributaries, but evaporation, freezeup, and seepage deplete these flows so that the middle and lower reaches of the main channel have only intermittent flows. The intermittent nature of streamflow affects water quality. It was observed that a flushing of dissolved solids and suspended sediment occurs during the first flows of a runoff event. A striking feature of the stream is its deeply incised channel. The downcutting is attributed to the cummulative effects of: (1) a change in the relative climate, amounts of annual precipitation occurring as rain and snow, (2) change in base level due to downstream channelization, and (3) changes in land use. Because of the incision, erosion is now expanding to include intervening tributaries. (USGS)
W82-06679

HYDROLOGY AND MODEL OF NORTH FORK SOLOMON RIVER VALLEY, KIRWIN DAM TO WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, and L. E. Stullken.
Available Univ. of Kansas Publ. Lawrence, Kansas. Kansas Ggeological Survey Irrigation Series 6, 1981. 34 p, 11 Fig, 2 Plates, 2 Tab, 11 Ref.

Descriptors: *Surface-groundwater relations, *Agriculture, *Aquifer characteristics, *Drought, Water shortage, Model studies, Irrigation water, Reservoirs, Rainfall-runoff relationships, Natural recharge, Groundwater storage, Water use, Wells, Water level, *Kansas, North Fork Solomon River valley.

Reservoir releases are the principal source of irrigation water in the North Fork Solomon River valley between Kirwin Dam and Waconda Lake. An extended drought in the 1970's caused severe water shortages. Ground water has been pumped from the alluvial aquifer in the valley to supplement irrigation supplies. Although annual pumpage increased to about 12,300 acre-feet in 1976, storage in the aquifer increased about 45,000 acre-feet from 1946 to 1976 as a result of recharge from surface-water irigation. A digital model was used to simulate aquifer conditions prior to closure of Kirwin Dam. Model results estimated recharge of 11,700 acre-feet per year from precipitation and discharge of 11,500 acre-feet per year from the aquifer to the river. Since 1946, discharge to the river has increased about 4,000 acre-feet per year. The analysis is inconclusive regarding effects of additional development, but the aquifer probably could sustain pumpage at the 1976 rate for several consecutive years of drought. (USGS)
W82-06684

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
For primary bibliographic entry see Field 4A.
W82-06826

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,
Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2B.
W82-06838

APPLICATION OF SCS INFILTRATION MODEL,
For primary bibliographic entry see Field 4D.
W82-06872

2B. Precipitation

VARIATIONS IN MOISTURE DEFICITS OVER THE MAIZE-GROWING REGION OF SOUTH AFRICA I. SPATIAL ASPECTS,
Missouri Univ.-Columbia. Dept. of Atmospheric Sciences.
J. F. Gillooly, and T. G. J. Dyer.
Water S. A., Vol 8, No 1, p 1-8, January, 1982. 11 Fig, 18 Ref.

Descriptors: *Rainfall, *Spatial distribution, South Africa, Distribution, Precipitation, Precipitation rate, Depth-area-duration analysis, Moisture deficiency, Moisture availability, Moisture, Evapotranspiration, Plants.

This paper deals with the spatial variations of the aridity index, termed the moisture deficits, over the officially defined maize-growing region of South Africa. This area produces about 95% of the total maize production and covers about 530,000 square kilometers. Measurements were taken of aridity for each of 25 weather stations. The total accumulated moisture deficit from July to the end of March provided the needed measure. It is noted that areas of high production coincided with areas experiencing large total moisture deficits. High production intensities were obtained through large areas being cultivated rather than high yields per se. When the intra-annual variation of mean monthly moisture deficits was determined over the maize growing

area, it was noted that the greatest variation occurred in the west and decreased in an easterly direction. Due to the erratic nature of rainfall over South Africa, monthly deficits of moisture were highly variable over time. Confidence limits were useful in determining the reliability of obtaining a particular monthly deficit in any given region. These results were then compared to the spatial patterns exhibited by the lower, median and upper quantities of rainfall, and found to be strongly related to the seasonal progression of rainfall from east to west across the maize growing area. (Baker-FRC)
W82-05901

ON PREDICTING THE ONSET OF THE AUSTRALIAN WET SEASON AT DARWIN,
Australian Numerical Meteorology Research Center, Melbourne.
N. Nicholls, J. L. McBride, and R. J. Ormerod.
Monthly Weather Review, Vol 110, No 1, p 14-17, January, 1982. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Rainfall, *Forecasting, *Prediction, *Weather forecasting, Weather data collections, Weather, Monsoons, *Australia, Darwin.

An index of the data of onset of the North Australian wet season is defined based on rainfall received at a single station at Darwin. This index can be predicted some months ahead of the onset. The total rainfall received over the period of the wet season is only weakly related to the onset index. Mid-late (December-May) season rainfall is totally independent of the date of onset and of the amount of early (September-November) rainfall. As noted in earlier research, the North Australian wet season is monsoonal in character. The current evidence suggests that the monsoon onset is preceded by a transition season, which at Darwin accounts for about 30% of the total wet-season rainfall, and there is also considerable temporal organization of transition season rainfall. This finding is supported by the fact that the date of accumulation of as little as 50 mm of rain is related to earlier months' pressure observations. (Baker-FRC)
W82-06208

ON A STATISTICAL RELATIONSHIP BETWEEN AUTUMN RAINFALL IN THE CENTRAL EQUATORIAL PACIFIC AND SUBSEQUENT WINTER PRECIPITATION IN FLORIDA,
Scripps Institution of Oceanography, La Jolla, CA.
A. V. Douglas, and P. J. Englehart.
Monthly Weather Review, Vol 109, No 11, p 2377-2382, November, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Rainfall, *Prediction, *Weather forecasting, *Florida, Gulf of Mexico, North Atlantic, North Pacific.

Attention is drawn to one strong and apparently useful teleconnection between autumn rainfall in the central equatorial Pacific and subsequent winter precipitation in south-central Florida. The regression equation relating the fall rainfall index and winter precipitation in south central Florida is based on 28 years of data. While a strong statistical relationship appears to exist between rainfall in Florida and the equatorial Pacific, the physical mechanisms associated with the teleconnection are undoubtedly complex. Examination of Northern Hemisphere 700 mb anomaly maps for wet and dry years along the equator has provided some insight. In preparing these maps, winter height anomalies were composited for six years with high autumn rainfall along the equator and six years with below-normal rainfall. Large scale circulation changes associated with warming events in the eastern tropical Pacific are noted. After the establishment of a warm-set regime in the eastern Pacific, the winter circulation becomes abnormally strong across the eastern North Pacific, Gulf of Mexico and western North Atlantic. The development of heavy precipitation in Florida is probably a result of a vigorous low-latitude mean flow across North America and increased frontal activity in the Gulf of Mexico. Cyclogenesis in the Gulf of Mexico may also increase during these winters. (Baker-FRC)
W82-06209

AUTOCORRELATIONS OF MOISTURE PARAMETERS ON ISENTROPIC SURFACES,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
J. S. Boyle.
Monthly Weather Review, Vol 109, No 11, p 2401-2404, November, 1981. 1 Fig, 20 Ref.

Descriptors: *Specific humidity, Mathematical studies, *Moisture, *Humidity, Atmospheric water, Atmosphere, Weather, *Weather forecasting, Prediction.

This note presents some spatial autocorrelation results for moisture variables on isentropic surfaces. These results appear to impact on the selection of an optimal technique for synoptic-scale moisture analyses. It was found that, within the context of the procedures used and for the case studied, the values of autocorrelation for specific humidity were greater than that of relative humidity for all separation distances considered, and that for almost all distances considered, the autocorrelation of specific humidity displayed a more gradual decrease with separation distance than did that of relative humidity. These findings are in concert with meteorological experience and indicate that some gains may be made in the accuracy of the moisture analysis by using specific humidity as the analyzed quantity. It is noted that an objective analysis scheme can make more effective use of the available moisture information if the analysis is made of specific humidity on isentropic surfaces rather than relative humidity on pressure or isentropic surfaces. (Baker-FRC)
W82-06210

RAINFALL AND ATMOSPHERIC CIRCULATION DURING DROUGHT PERIODS AND WETTER YEARS IN WEST AFRICA,
National Center for Atmospheric Research, Boulder, CO.
S. E. Nicholson.
Monthly Weather Review, Vol 109, No 10, p 2191-2208, October, 1981. 17 Fig, 4 Tab, 33 Ref.

Descriptors: *Rainfall, *Variability, Atmospheric water, Drought, Sahara Desert, Arid climates, Africa, *West Africa, Climatology, *Rainfall distribution, Precipitation.

Rainfall variations of the present century over a large section of the African continent were investigated. The general climatology of the areas of the African continent were investigated. The general climatology of the areas in question is reviewed along with a summary of modern rainfall fluctuations in various regions, and recent extreme rainfall anomalies are described. During recent decades the Sahel and other sub-Saharan regions experienced two periods of anomalous rainfall conditions, the wet 1950's and the drought of 1968-73. A comparison of sub-Saharan droughts and wetter years suggests that a northward displacement of the Intertropical Convergence Zone may account for wetter years, but that a weakened 'intensity' of the rainy season, independent of ITCZ position, is the most likely cause of drought in the sub-Saharan region. Increased subsidence and decreased low-level convergence over the sub-Sahara and a decrease of moisture flux and upper level easterly flow into that region accompany drought years. The last factor weakens the combined barotropic-baroclinic instability mechanism which maintains the rain-producing West African disturbances, and it probably diminishes the westward steering of these disturbances. The synchronous rainfall changes on both sides of the Sahara, indicating a change in both the tropical summer rainfall regime and the extratropical winter rainfall regime, strongly imply a general intensification of the Hadley cell and perhaps an expansion of its descending branch. Further evidence of this derives from increased rainfall in equatorial regions during sub-Saharan droughts, usually associated with a contraction of the equatorial 'rainy' zone, the ascending branch of the Hadley circulation. (Baker-FRC)
W82-06211

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
S. W. Wolcott, and T. T. Warner.
Monthly Weather Revies, Vol 109, No 9, p 1989-1998, September, 1981. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Rainfall, *Forecasting, Weather forecasting, Prediction, Satellite technology, Wind, Precipitation, Remote sensing, Model studies, Mathematical studies, *Moisture.

A moisture analysis procedure is presented that uses satellite, precipitation and surface specific humidity data to augment the standard radiosonde observation (RAOB) of moisture. Mesoscale forecasts were made to determine the effect of the high-resolution moisture analysis on the forecast of precipitation. The analysis procedure uses the RAOBs as the primary source of synoptic scale information, with the other sources adding mesoscale detail to the analysis. Precipitation data and satellite-determined cloud data provide the basis for a relative humidity constraint with the potential for providing high-resolution information, whereas the surface specific humidity analysis introduces fine scale information on low level moisture patterns. All forecasts produced rainfall amounts considerably smaller than those observed, even though the positioning of the rain events was good. The most realistic rainfall amounts were produced by the mode when the saturation constraint was imposed by the use of satellite and surface observed 'present weather' data. Rain rates during the first 4 hr of these forecasts were 100% larger and more realistic than the rain rates produced when these data were not used. The fine scale structure to the moisture field at the lowest model level as provided by surface based specific humidity data did not significantly affect the precipitation prediction. A strong synergistic effect exists between the initial latent heat release in the model and the divegence field that exists in the model initial conditions. The extent of the positive influence of the satellite and surface present weather data, at least during the early hours of the forecast, was probably related to the existence of the relatively sophisticated divergent wind initialization. (Baker-FRC)
W82-06212

THE 1980 SUMMER HEAT WAVE AND DROUGHT IN HISTORICAL PERSPECTIVE,
National Climatic Center, Asheville, NC.
T. R. Karl, and R. G. Quayle.
Monthly Weather Review, Vol 109, No 10, p 2055-2073, October, 1981. 16 Fig, 1 Tab, 17 Ref.

Descriptors: *Drought, *Weather patterns, Weather data collections, Soil moisture, United States, Climates.

The summer of 1980 is put into historical perspective with the aid of state temperature and precipitation averages for the 48 continguous states of the United States 1985. Several other variables and indices were also derived to assess the oppressive weather during this particular summer. These indices include the Palmer Drought Severity Index (PDSI) and Palmer's soil moisture abnormality index (Z Index). Population-weighted cooling degree days as related to electrical energy sales and the deficit of the precipitation minus the potential evapotranspiration were also used in the assessment. The heat during the summer of 1980 was near record levels in many states throughout the Southern Plains and eastward along the Gulf Coast to the Atlantic. Probably the most notable aspect was the most anomalous areas followed two decades of relatively cool summers. the cooling degree day total across the nation during the cooling season of May-October was the highest since 1959. Electicity consumption reached new peaks, partly as a result of natural growth and partly because of the increased air conditioning load. Economic losses during this hot, dry summer were estimated at $16 billion. However, during the 1930's and 1950's even worse conditions had existed. (Baker-FRC)
W82-06213

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TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
E. B. Rodgers, and R. F. Adler.
Monthly Weather Review, Vol 109, No 3, p 506-521, March, 1981. 13 Fig, 2 Tab, 25 Ref.

Descriptors: *Satellite technology, *Rainfall distribution, Nimbus, Remote sensing, Data collections, Precipitation, Rainfall, Cyclones, Tropical cyclones, Storms, Hurricanes, Pacific Ocean.

Results are presented from the calculation of the magnitude and distribution of rainfall in Pacific Ocean tropical cyclones using the EMSR-5 data (Nimbus-5 Electrically Scanning Microwave Radiometer). Approximately 70 satellite passes over tropical cyclones in various states of development were used. All storms examined reached typhoon or hurricane stage sometime during their lifetime. The data have been useful in determining the rainfall characteristics of these storms and appear to be potentially useful in monitoring and making short term predictions of their intensity. Comparison of the ESMR-5 derived total storm rainfall calculations with previous estimates based on moisture budget computations or composited rainfall statistics indicate good agreement for both mature systems (typhoons) and disturbances, except in the inner core, where ESMR-5 measurements seem to understimate rainfall rate. The calculations confirm that total typhoon rainfall is about twice that found in disturbances. Case studies as well as composite studies indicate that the increase in the ESMR-5 derived latent heat release corresponds to storm intensification. In addition, the relative contribution of the heavier rainfall rates to the total storm rainfall also increases as tropical cyclones intensify. A tendency was also noted for the rainfall to concentrate toward the center during intensification. Comparisons of eastern Pacific Ocean hurricanes and western Pacific Ocean typhoons shows that the eastern storms have less LHR, are more compact and have less intense rainfall. (Baker-FRC)
W82-06214

OBJECTIVE ANALYSES AND MAPPING TECHNIQUES FOR RAINFALL FIELDS: AN OBJECTIVE COMPARISON,
Centre National de la Recherche, Scientifique, Grenoble (France). Inst. de Mecanique.
J. D. Creutin, and C. Obled.
Water Resources, Vol 18, No 2, p 413-431, April, 1982. 13 Fig, 37 Ref.

Descriptors: Rainfall, *Mapping, *Precipitation, *Isohyets, *Statistical analysis, Spatial distribution, estimating, Regression analysis, Mathematical studies, Correlation analysis, Field investigations, Isotropy.

Techniques to estimate point or average values of rainfall fields at ungaged sites are reviewed. Some theorectical developments and practical aspesct of various techniques are cited. In general, it was concluded that interpolation methods provide better results than smoothing techniques. No statistical methods are able to fully account for both the climatological and spatial properties of rainfall fields. A case study is presented for a region with particularly high rainfall variability, the Massif Central in France, to compare the sensitivity of various techniques. Correlation and contingency analyses were conducted. Results suggest that the Gandin method is preferred by hydrologists, because it requires only one calibration, it provides the estimation error variance as a by-product, and it is the most computationally efficient. (Titus-FRC)
W82-06327

CALCULATIONS OF HAILSTONE GROWTH IN A SLOPING STEADY UPDRAFT,
Chicago Univ., IL. Dept. of Geophysical Sciences.
W. D. Robinson, and R. C. Srivastava.
Atmosphere-Ocean, Vol 20, No 1, p 76-89, 1982. 8 Fig, 24 Ref.

Descriptors: *Hail, *Cloud physics, Precipitation, Model studies, Air circulation, Fleming storm, Rainstorms.

Hail growth in a model cloud was investigated with analytical solutions to equations of growth and motion in hailstones in updrafts. Cloud water contents varied linearly with height. The two-dimensional steady state model of a storm consisted of several sections in the horizontal and the vertical in each of which the vertical air velocity and the effective cloud water content were linear or piecewise linear functions of height and were consistent in the horizontal direction. This procedure approximated the Fleming storm. Hail embryos (0.1 cm in diameter) were introduced at several positions in the updrat from 5 to 10 km. Spacings were 1 km and 0.5 km in the vertical and horizontal dimensions, respectively. The largest hailstones (up to 5.7 cm) were formed from embryos starting near the (right) downshear edge of the updraft. These embryos recirculated, with the number of recirculations and final size being greatest in those embryos originating nearest to the turnover location of the updraft. Small hailstones (< 0.5 cm), likely to melt before reaching the ground, were formed from embryos starting in the central portions of the updraft and near the upshear edge of the updraft. (Cassar-FRC)
W82-06526

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
P. L. Smith.
Atmosphere-Ocean, Vol 20, No 1, p 4-16, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Rain, *Fluid drops, *Particle size distribution, Graphical analysis, Mathematical studies.

Five graphical methods for describing raindrop size data are discussed. These methods can determine the form and estimate the parameters of drop size distribution functions. Each gives a different view of drop size distribution and each has certain advantages in different applications. All methods show that drop size distribution is approximately exponential. The pioneering work of Marshall and Palmer (1948) is less satisfactory for many purposes than subsequently developed methods. The most useful forms for fitting functions to observed drop size data are the semilogarithmic plot of the inverse cumulative drop size distribution vs. drop diameter and a plot of normalized cumulative mass concentration vs. normalized drop diameter. They are also useful in examining the possibility of truncation of distribution. (Cassar-FRC)
W82-06529

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,
Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
For primary bibliographic entry see Field 7B.
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-06531

ON ACCUMULATION OF WATER SUBSTANCE IN A COLUMN OF RISING AIR,
National Severe Storms Lab., Norman, Ok.
E. Kessler.
Atmosphere-Ocean, Vol 20, No 1, p 62-68, 1982. 1 Fig, 11 Ref.

Descriptors: *Condensation, *Air circulation, *Storms, Clouds, Model studies, Precipitation, Updrafts, Meteorology, Hail.

The accumulation of condensed water in moist rising air is related to the ratio of air speed to the fall speed of precipitation. Maximum accumulation occurs when the ration is near unity. Accumulation of water is considered in one-dimensional time-dependent distributions in three model situations: (1) updrafts are substantially less than precipitation fall speeds (weak updrafts), (2) updrafts and fall speeds are about equal (moderate updrafts), and (3) updrafts are substantially greater than fall speeds (strong updrafts). The accumulation is described by equations reflecting the relative importance of vertical advection, condensation, and three-dimensional divergence of rising air. Equations also define the times required for almost steady conditions to be achieved in the saturated rising columns. The length of the transient phase is proportional to the inverse of the precipitation fall speed in weak updrafts and to the inverse of air speed in moderate or strong updrafts. An idealized figure reveals how precipitation predominates at the base of weak updrafts and throughout most of the depth of moderate updrafts. A strong updraft is marked by cloud at lower altitudes, with precipitation mostly confined to altitudes above the updraft maximum. (Cassar-FRC).
W82-06581

THE EFFECT OF PRESSURE ON THE BREAKUP OF ONE PAIR OF RAINDROPS,
Toronto Univ. (Ontario). Dept. of Physics.
R. List, and C. Fung.
Atmosphere-Ocean, Vol 20, No 1, p 17-27, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Fluid drops, *Rain, *Coalescence, Kinetics, Precipitation, Atmospheric pressure.

A new apparatus measured the effect of pressure on the breakup types and fragment spectra resulting from water drops with diameters of 2.61 and 1.17 mm colliding while moving vertically at terminal speed. The same types of breakup were observed at 50 to 100 kPa. Pressure did not appear to affect fragment size distribution for breakup into filaments, sheets, and disk patterns; average fragment numbers; or coalescence efficiency. Whenever the larger drop was hit in a glancing fashion, a neck of filament was formed. A more central collision led to a two-dimensional sheet of water ripping out of the larger drop, with the smaller drop disappearing. A central hit produced a horizontal disk. These breakup types occurred at about the same frequency as with the 3.0, 1.0 mm pair of drops at 100 kPa in a previous experiment. At kPa 2250 attempted collisions produced 104 actual collisions. Of these 104 collisions three disk modes coalesced, and 101 led to breakup. The empirical equation developed by Low (1977) and Low and List (1982) predicted the dependence of fragment numbers and size distributions on drop diameters when extrapolated from 100 to 50 kPa. However, the collision kinetic energy factor had to be adjusted by a multiplication factor. (Cassar-FRC)
W82-06761

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),
Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
L. -R. Kruger, and G. A. Schultz.
Wasserwirtschaft, Vol 72, No 1, p 1-5, 1982. 8 Fig, 7 Ref.

Descriptors: *Satellite technology, *Rainfall, *Runoff, *Convection, *Infrared imagery, Water resources development, *West Germany, Mathematical models, Mathematical equations, Clouds, Temperature effects, Air temperature, Cloudbursts, Precipitation, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, *Remote sensing, *Metrostat.

The use of data from the infrared channel of the geostationary satellite METEOSTAT to locate and analyze convection precipitation is described. The technique can be used to partly fill gaps in hydrological data that have, particularly in the

developing countries, hindered the smooth functioning of water resources projects. The METEOSTAT provides the extensive scan in terms of both time and space required to analyze the origin of convection rainfall in its local variability and quick occurrence. Rainfall data can then be convertd to runoff with the aid of a deterministic precipitation/runoff model. The satellite is located 36,000 km above the equator at 0 degrees longitude and possesses the same angular velocity as the earth (hence it is geostationary). The infrared channel (10.5-12.5 micrometers) delivers information on the temperature of ground, water, and cloud surfaces. The satellite covers 25 sq km at the subsatellite point and above 45 sq km over central Europe. It delivers an image of almost half the earth's surface about every 30 min. Using a test area of southern Germany, the data indicated that the lower the temperature of the cloud surface, the higher the probability of the existence of ice crystals and their growth (these eventually fall to the earth as rain) and the more powerful the extent of the convection cell and hence the greater the precipitation efficiency. The data also showed that a large temporal temperature change of the upper edge of the cloud is an expression of the inner dynamics of the convectional cell; a temperature drop indicates a fast rise of the cumulonimbus. The parameter that allows rain volume to be calculated from rain intensity is the area of the cloud. An equation is given for this. In principle, METEOSTAT provides infrared information for every catchment area on earth, but research is required to devise more accurate methods of interpreting the data. (Gish-FRC)
W82-06823

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,
Scripps Institution of Oceanography, La Jolla, CA.
G. K. Vallis.
Tellus, Vol 34, No 3, p 211-227, June, 1982. 17 Fig, 2 Tab, 45 Ref.

Descriptors: *Model studies, *Climates, *Climatic zones, *Climatology, Mathematical studies, Hydrology, Hydrologic models, Hydrologic cycle, *Statistical studies.

A zonally averaged statistical dynamical climate model is described, and various experiments are performed with it. The model is based on the primitive equations of motion, except that the zonally averaged zonal wind is constrained to be in a 'spherical geostrophic equilibrium' with the geopotential. The effects of large scale eddies on zonally averaged flow are parameterized using a scheme based on the work of Green. The solar and infrared radiation schemes allow interaction with the cloud cover predicted via a hydrology cycle. When integrated, the model produces realistic energetics and fields of momentum, temperature and relative humidity. The effects of moisture on the model circulation are examined. Its inclusion intensifies and narrows the upward branch of the Hadley cell, although the total width is unaltered. The response of the surface temperature to changes in the solar constant is reduced by moisture, especially at low latitudes. Relative humidity is found to have an inverse relationship to surface temperature if surface albedo is fixed. However, the presence of an ice sheet reduces low level relative humidity. Implications for simple energy-balance models and climate sensitivity are discussed. (Baker-FRC)
W82-06838

SPATIAL COHERENCE OF MONTHLY PRECIPITATION IN THE UNITED STATES,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh, M. B. Richman, and D. W. Allen.
Monthly Weather Review, Vol 110, No 4, p 272-286, April, 1982. 10 Fig, 6 Tab, 37 Ref.

Descriptors: *Spatial distribution, *Air circulation, *Weather patterns, Precipitation, Factor analysis, Synoptic analysis, Cyclones, Seasonal variation, Areal precipitation, Meteorology, Weather forecasting.

Synoptic-scale regions of the U.S. over which monthly precipitation amounts showed the greatest spatial coherence were identified by factor analysis and an orthogonal rotation to the varimax criterion. Data consisted of monthly precipitation amounts for the years 1900-77 at 61 stations. Results showed nine patterns, which permitted delineation of the large-scale circulation features most closely associated with fluctuations of regional precipitation. Correlations between regional precipitation and parameters of the 700 mb height field were significant locally and corresponded to 10-50% of the monthly precipitation variance. Patterns were consistent with previously documented cyclone trajectories, and the corresponding time series of the factor scores were highly correlated with values of the Palmer Drought Index. The seasonal continuity of the patterns was disrupted only in summer, when the predominance of convective precipitation resulted in a minimum of spatial coherence. Sea level pressure anomalies over broad areas of the Atlantic and Pacific Oceans were associated with regional precipitation in the central and eastern U.S. The correlations with precipitation along the West Coast were more localized. These results may be useful in long-range prediction of precipitation. (Cassar-FRC)
W82-06894

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 6G.
W82-06967

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,
Meteorological Satellite Center, Tokyo (Japan).
For primary bibliographic entry see Field 7B.
W82-06995

2C. Snow, Ice, and Frost

THE IMPORTANCE OF REFREEZING ON THE DIURNAL SNOWMELT CYCLE WITH APPLICATION TO A NORTHERN SWEDISH CATCHMENT,
Luleap Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 13, No 1, p 1-12, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Snowmelt, *Mathematical models, *Freezing, *Snow pack, Model studies, Temperature effects, Thaw, Snow cover, Snow melting, Mathematical studies, *Sweden.

A method for calculating night-time refreezing of the top layer of a snowpack which may be used in the degree-day technique for computing daily snowmelt rates is presented. For days with considerable variations in temperature, the total snowmelt will not be calculated accurately by the degree-day method, unless overnight refreezing is accounted for. For such days, the daytime conditions rather than the mean conditions over the whole day determine the snowmelt that takes place. The corrected model was applied to an open field and a forested area of the Bensbyn catchment area of northern Sweden. Whereas the simple degree-day method showed too fast a snowmelt rate, the refreezing-degree-day method was found to be very accurate for describing the snowmelt process. The refreezing-degree-day approach should prove easy to incorporate into existing conceptual mathematical runoff models. (Geiger-FRC)
W82-05942

COLD REGIONS ENGINEERING IN NORWAY,
Norwegian Road Research Lab., Oslo.
For primary bibliographic entry see Field 8A.
W82-06000

AN OPERATIONAL NET SHORTWAVE RADIATION MODEL FOR GLACIAL BASINS,
Toronto Univ. (Ontario), Dept. of Geography.
D. S. Munro, and G. J. Young.
Water Resources Research, Vol 18, No 2, p 220-230, April, 1982. 8 Fig, 1 Tab, 24 Ref.

Descriptors: *Net radiation, *Model studies, *Snowmelt, *Reflectance, *Glaciology, *Mapping, Radiation, Runoff, Glaciers, Ablation, Glaciohydrology, Snowline, Melting, River basins.

An operational net shortwave radiation model which is useful in mapping the distribution of shortwave radiation arriving at sloping surfaces throughout a glacier basin is described. The model is constructed by modifying existing total spectrum approaches to minimize the need for observational data during operation. Radiation distribution may be mapped under clear or cloudy skies, and knowledge of the surface reflectance field must be incorporated to estimate the net shortwave radiation absorbed by ice and snow. The model was successfully applied using topography data, monitoring of the snowline, and routine weather studies at Peyto Glacier Basin, Alberta. Model net shortwave radiation estimates were fair approximations of energy equivalents of ablation derived from stake measurements. The net shortwave radiation measurement was recommended for use in modeling the meltwater discharge of glacier basins. (Geiger-FRC)
W82-06064

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W82-06065

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W82-06082

BACTERIA UNDER THE ICE,
For primary bibliographic entry see Field 5A.
W82-06561

ALBEDO SURVEY ON ANDREI GLACIER, ISKUT RIVER BASIN, B. C., MIDSUMMER, 1980,
Department of the Environment, Ottawa (Ontario).
S. Fogarasi.
National Hydrology Institute, NHRI Paper No 15, 1981. 13 p 6 Fig, 5 Tab, 1 append.

Descriptors: Water resources, *Geological survey, *Glaciers, *Data analysis, *Statistics, Surface Contamination, *British Columbia, *Albedo, Andrei Glacier.

At nine sites on Andrei Glacier, B.C., albedo measurements were carried out on ice surfaces which were contaminated to varying degrees. Four albedo classes were derived in terms of the amount of aeolian dirt that was deposited on the ice surface. Each albedo class was associated with one of the 'white', 'whitish', 'dirty' or 'very dirty' surfaces, and each class had signigicantly different albedos, the means of which ranged from 22% to 68%. Values in each albedo group were normally distributed over time. Albedos from wet ice surfaces were found between the -2 and -3 standard deviation band of each albedo class distribution. Albedo values measured on freshly frozen ice surfaces tended to occupy the upper tail of the Gaussian normal distribution, i.e., between +2 and +3 standard deviations. Albedo values have been tabulated and plotted along a grid of 500-m mesh. Finally, suggestions are given on how to model

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hourly ice surface albedo distribution over the glacier. (WATDOC).
W82-06578

2D. Evaporation and Transpiration

LIQUID LEVEL INTERFEROMETER,
Arizona Univ., Tucson. Optical Sciences Center.
For primary bibliographic entry see Field 7B.
W82-05929

REGIONAL WATER BALANCE ON THE ARCTIC TUNDRA IN SUMMER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 301-305, April, 1982. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Tundra, *Evaporation, *Precipitation, *Arctic zone, *Altitude, *Hydrologic budget, Evaporation rate, Energy, Lysimeters, Runoff, Snowmelt, Hydrologic data collections, Snow cover.

During the summers of 1969 and 1970, the regional distributions of evaporation and precipitation were examined on the arctic tundra on Axel Heiberg Island, Northwest Territory, Canada. Measurements were made using small weighing lysimeters and Canadian standard rain gauges stationed at eight locations ranging in altitude from sea level to 800 m above the means sea level. During the snow-free period, the means evaporation rate increases slightly with altitude. At higher altitudes, the total evaporation for the snow-free period is shorter due to the longer duration of the snow cover. The total summer evaporation is at a maximum in the 100-600 m altitude range, while total summer precipitation increases steadily with altitude, exceeding evaporation at about 500 m. Below 500 m, most of the annual runoff occurs during and immediately after the winter snowmelt. Above this altitude, runoff takes place throughout the summer. (Geiger-FRC)
W82-06061

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 291-300, April, 1982. 6 Tab, 3 Fig, 18 Ref.

Descriptors: *Arctic zone, *Tundra, *Evaporation rate, *Snowmelt, *Precipitation, *Runoff value, Arctic, Hydrologic data collections, Evaporation, Sublimation, Lysimeters, Snow cover, Rime, Snowdrift, Energy, Hydrologic budget.

Hourly and daily evaporation rates were recorded on arctic tundra during an energy balance program of the Axel Heiberg Island Expedition in spring and summer of 1969, 1970, and 1972. Objective criteria were developed to accept or reject the aerodynamic profile method of data collection for the Bowen ration energy balance procedure. Readings from the snow lysimeter and the ordinary weighting lysimeter were affected by snowfall, snowdrifting, rime deposition and lack of ventilation. The annual total evaporation for the base camp of the Axel Heiberg Island Expedition was estimated at 140 mm. This rate increases slowly from April to the beginning of the melt in mid-June, while the ratio of latent heat flux to net radiation decreases. The maximum annual evaporation rate is observed immediately after the melt. Total evaporation during the snow-free period accounts for about 85% of the annual total evaporation. Winter snow cover at the base camp contains an average water equivalent of 76 mm, while summer precipitation averages 95 mm. It was estimated that as much as 80% of the annual precipitation is lost into the atmosphere through evaporation, leaving only 20% for runoff, which occurs mostly during and immeditely after the melt period. (Geiger-FRC)
W82-06065

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,
Rhode Island Univ., Kingston. Dept. of Chemistry.
P. I. Abell.
Nature (London), Vol 297, No 5864, p 321-323, May 27, 1982. 3 Fig, 20 Ref.

Descriptors: *Lake evaporation, *Isotope studies, *Paleoclimatology, *Oxygen, *Lake sediments, *Sedimentology, *Gastropods, Evaporation, Isotopic tracers, Climatology, Water level fluctuations, Lakes, Air temperature, Relative humidity, *Kenya, Lake Turkana.

The well-preserved mollusc shells in the sedimentary column of Lake Turkana, Kenya were utilized to study the palaeoclimatology of the area using an oxygen isotope technique. The shells of three species of abundant gastropods were ground to a powder and examined for aragonite/calcite ratios and oxygen isotope (O18/O16) ratios. The sensitive oxygen isotope record varied over a range of 7%, reflecting higher evaporative levels of the heavier oxygen isotope in lake waters during periods when the lake was closed, alternating with isotopically lighter freshwater during periods when the lake was open. The mapped climatic trends derived from this technique are comparable to those observed in parts of Africa today. The warm/dry periods which have characterized much of the past at Lake Turkana and which prevail today have also been noted in oxygen isotope ratios from modern gastropods at Lakes Victoria, Edward, Albert, and Kivu, suggesting that temperature rather than relative humidity is the major factor controlling the evaporative concentration of O18. (Geiger-FRC)
W82-06216

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,
Northeastern Forest Experiment Station, Durham, NH.
C. A. Federer.
Water Resources Research, Vol 18, No 2, p 355-362, April, 1982. 5 Tab, 6 Fig, 23 Ref.

Descriptors: *Simulation analysis, *Mathematical models, *Transpiration, *Atmosphere, *Soil environment, Stomatal transpiration, Water loss, Transpiration depletion, Flow roots, Plant-water potential, Water potentials, Field investigations, *Maine.

The accuracy and usefulness of two forms of water demand functions and two forms of water supply functions are considered. The effects of various soil and plant factors on transpiration are examined using a simulation model to produce transpiration values. The model simulates diurnal and seasonal behavior of plant and soil water potentials, stomatal conductance, and transpiration, and has been tested on two hardwood forests. Data from a birch-oak-pine forest in southern Maine were used. The study showed that the best estimate of atmospheric demand, unstressed transpiration, can be obtained by the Penman equation for short vegetation, but with forest canopies, transpiration is highly variable. The best estimate of supply incorporates depth variation of soil water potential and of root and soil properties, but a more practical index can be used which measures the fraction and available water in the root zone. Results of the study suggest that supply is less than demand only when the soil is very dry. (Titus-FRC)
W82-06320

POTENTIAL EVAPORATION IN THE PEACE REGION OF BRITISH COLUMBIA,
British Columbia Ministry of Environment, Victoria.
R. L. Davis, and J. A. Davies.
Atmosphere-Ocean, Vol 19, No 3, p 251-260, 1981. 5 Fig, 13 Ref.

Descriptors: *Evaporation, *Net radiation, *Energy, Model studies, Peace River, *Briish Columbia, Pastures, Solar radiation, Radiation.

The Priestly and Taylor (1972) model for potential evaporation performed well when tested with micrometeorological data collected over pasture in the Peace River region, British Columbia. Data were collected from mid-May until late August, 1977, during which a total of 285 mm of precipitation fell on 55 days. The volumetric soil moisture content of the root zone always exceeded 32%, insuring evaporation at the potential rate. The root mean square error was less than 10% of the mean evaporation rate on a daytime basis using an alpha rate (vapor pressure deficit) of 1.26. Net radiation, rarely measured in remote areas, was estimated from more readily available meteorological data. On the average, calculated results of net radiation were 7% higher than observed values, producing a 7% overestimate of evaporation. Calculated results of net radiation were also within 20% of measured values on a daily basis and within 10% on a 5-day mean basis. (Cassar-FRC)
W82-06528

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,
Bureau of Land Management, Denver, CO.
B. P. Van Haveren.
Water Resources Bulletin, Vol 18, No 3, p 533-536, June, 1982. 6 Fig, 2 Ref.

Descriptors: *Measuring instruments, *Evaporation pans, Evaporation, Flow discharge, Remote sensing, Telemetry, Automation.

A simple, reliable, and relatively inexpensive automated recording system for evaporation plans is described. With this system, a continuous record of pan evaporation is obtained. The evaporation station may be left unattended for periods of up to 30 days, and with incorporation of a data telemetry system, could be operated on a real-time basis. Measurement sensitivity and frequency of maintenance trips can be determined by the investigator simply by choice of reservoir diameter and volume. The system is particularly well suited for remote evaporation stations. The major advantages of the system over conventional, manually read evaporation pans are: (1) savings in manpower and travel expenses, (2) continuous recoding function, and (3) adaptability to real time data acquisitions systems. Data retrieval and storage can be by conventional paper strip chart, punch tape, cassette tape data logger, or telemetry. The system could be operated in cold weather by substituting a mixture of methanol and water for water in the evaporation pan. For more sophisticated applications, the float valve can be replaced by an electronic circuit to sense water lever and a solenoid valve to control water flow to the pan. (Baker-FRC)
W82-06780

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),
Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
J. Werner.
Wasserwirtschaft, Vol 72, No 1, p 18-22, 1982. 6 Fig, 15 Ref.

As a result of several years' investigation of energy exchange at the boundary of water and air, equations for the calculation of this phenomenon are given whose practicability has been proven. The use of these equations in an arithmetic model opens up the possibility of extrapolation to extreme situations, whether these caused by a long period of extraordinary atmospheric conditions or changes in the natural temperature balance of a body of water induced by man (e.g., warmth from a wastewater stream). Developments in microprocessor technology have made it possible to monitor energy exchange at water surfaces continuously by means of a floating buoy and to balance them in situ. The buoy allows determination of evaporation loss as well as arithmetic simulation of equilibrium temperatures. The simplest form of such a buoy is furnished with a device for measuring radiation balance, a cup anemometer and an evaporation psychrometer. The buoy

should be about 1 m high so that maintenance can be carried out comfortably from a boat, and this permits calculation of energy exchange up to 3.3 m above the water surface. In running water a flow meter should be installed to distinguish the relative movement between water and air from wind speed actually affecting the surface. Equations are given for the calculation of short- and long-wave radiation exchange and of the vertical flows of latent and perceptible heat. The temperature of water is determined by the total radiation exchange, which in turn is determined by energy gain from global radiation and by heat loss through reflected radiation as well as by evaporation loss and the exchange of perceptible heat. (Gish-FRC)
W82-06824

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
M. E. Andersen, and H. E. Jobson.
Water Resources Research, Vol 18, No 3, p 630-636, June, 1982. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Model studies, *Lake evaporation, *Evaporation, Lakes, Mathematical models, Maps, Temperature effects, Humidity, *Climatic data, Water loss.

A numerical model and an evaporation map were used to determine mean annual evaporation estimates for 30 lakes. The map used had been derived from a computer model with contour lines showing average annual lake evaporation in the southeastern United States which had been superimposed on a map that was created using 10 year average values of pan evaporation and related meteorological data along with observed evaporation from 10 lakes. The evaporation map thus produced provides annual evaporation estimates that are more consistent with observations than those determined by use of the numerical model. The map cannot provide monthly estimates, however, and is only available for the contiguous United States. The numerical model can provide monthly estimates for shallow lakes and is based on monthly observations of temperature, humidity, and sunshine duration. (Baker-FRC)
W82-06850

2E. Streamflow and Runoff

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
A. K. Tyagi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243429, Price codes: A02 in paper copy, A01 in microfiche. Report, December 1981. 18 p, 3 Fig, 25 Ref. OWRT A-103-OKLA(1), 14-34-0001-1138.

Descriptors: *Streamflow forecasting, *Model studies, *Model testing, *Routing, *Finite element models, Forecasting, Prediction, Projections, Mathematical studies, Flow index, Diversion, Discharge capacity, Discharge coefficient, Flow discharge, Flow measurement, Computer models, Mathematical models, Mathematical analysis.

Application of finite element (FE) methods to unsteady flow equations is presented for predicting depth, velocity, and volume flow rate in a stream. Two simplified FE models (the explicit and weighted-implicit FE models) are proposed as methods appropriate to streamflow routing. The equation of continuity (conserving the mass of flow) is completely retained; the equation of momentum (conserving the flow momentum) is modified to account only for the friction and gravity terms. This study sought to develop an efficient simple model capable of accurately predicting discharges with little or no computational problems; the weighted-implicit model was developed and tested for this purpose for a flood routing problem. The flood hydrograph results obtained from testing both FE models agree closely with a previously-found solution. The weighted-implicit FE model was determined to yield accurate results, with a maximum time interval of 10 minutes and a weighting factor in a range of 0.55-1.00. Delineation of the mass and momentum conservation equations for the overall mathematical model is provided. (Zielinski-MAXIMA)
W82-05918

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. C. Lazaro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243502, Price codes: A11 in paper copy, A01 in microfiche. PhD Thesis, Fall, 1981. 212 p, 28 Fig, 16 Tab, 94 Ref, 2 Append. OWRT B-201-COLO(2).

Descriptors: *Streamflow forecasting, *Water use efficiency, *Computer models, *Management planning, *Operating policies, Streamflow, Planning, Water demand, Water supply, Model testing, Model studies, Forecasting, Water conservation, Water requirements, Simulation analysis, River basin development, Prediction, Flow discharge.

Due to increased competition for available water supplies in the western U.S. and political and financial considerations that new water supply development, recent attention has been focused on more effective operations to enhance water supply and use efficiency. A package of computerized management models is offered for monthly operational planning of complex water resource systems supplied by snow-fed streams. The three basic parts of the package consist of: a state-space water supply forecasting model (accounting for future streamflow uncertainties); a methodology for treating substantially different streamflows; and a river basin management model having simulation and optimization capabilities. Model parameters, forecasts, and the resultant operational plan can be adaptively updated as new information is obtained in real-time. The forecasting model is based on historical patterns identified from derived monthly streamflow records; forecasted monthly streamflow serves as an input to the river basin management model to simulate water storage and system flows. The Cache La Poudre river basin in north-central Colorado was used as the case study to show capability and use of the management package. Package application reduced waste surface water leaving the system. System outflow reduction is dependent on the reservoir maximum safe storage volume and the minimum amount that can be wasted or no longer diverted for storage. (Zielinski-MAXIMA)
W82-05926

STATISTICAL FLOOD FLOW ESTIMATION,
E. Reinius.
Nordic Hydrology, Vol 13, No 1, p 49-64, 1982. 5 Fig, 8 Tab, 9 Ref.

Descriptors: *Flood frequency, *Graphical methods, *Frequency analysis, *Frequency distribution, Mathematical studies, Graphical analysis, Flood peak, Probability distribution, Mathematical equations, Flood discharge, Flood flow.

When the frequency analysis of flood flows is calculated by the grapical method of plotting on probability paper the results obtained are different from results calculated by the analytical method. If both methods were correct, the position should coincide with the mean of the probabilities which the observation of a rank has in a great number of samples, each with the same size. A study using synthetic samples demonstrated that these positions do not coincide with the line of population. Another study indicated that the positions of the probabilities of the expected-mean-values of the largest observation coincide with the line of the population. It was therefore concluded that the logarithm of the annual peak flows should obtain a plotting probability equal to the probability of the expected value of the logarithm of the observations. A new plotting position formula based on these observations is derived. (Geiger-FRC)
W82-05945

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,
Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
C. P. R. Roberts, and W. J. R. Alexander.
Civil Engineer in South Africa, Vol 24, No 1, p 17-21, 24, 25, 27, January, 1982. 16 Fig, 5 Tab, 4 Ref.

Descriptors: *Floods, *Urban areas, Metropolitan areas, Laingsburg, *South Africa, Flood plain zoning, Floodwater, Historic floods, Flood damage, Flood control, Planning, Flood profiles.

The objective of this paper is to highlight the circumstances of the Laingsburg flood, South Africa 1981, which aggravated the loss of life and damage and the considerations which were taken into account in establishing the re-development line for the town. General conclusions drawn from these events are applicable to urban development on flood plains. Laingsburg is situated about 230 km northeast of Cape Town on the banks of the Buffels River, which flows in a southerly direction to join the Touws River, forming the Groot River, eventually turning into the Gouritz River. The Floriskraal Dam is located 20 km downstream of Laingsburg and was completed in 1957. The flood caused the loss of much property and 90 lives. Damage resulted from a combination of a number of aggravating circumstances. The flood arose from a typical black south-eastern weather situation and was estimated to be one of the largest recorded in South Africa, taking the size of the catchment area into account. Aggravating circumstances included the location of Laingsburg itself; the effect of tributary rivers; demolition and scour effects of the flood waters; the deposition of sediment particularly nearest to the enlarged river channel, where there is a rapid decrease in the velocity of the flowing water; floating debris which caused much damage in the town; and structural collapse of many buildings due to high water lovels alone. The effects of bridges across the Buffels River were a problem, as the flood size was 4 to 6 times greater than the size of the flood that would normally be taken into account for the design of road and rail bridges. The primary factor causing the high loss of life was that people could not anticipate that the water would reach such high levels, as there was no historical precedent for this. (Baker-FRC)
W82-05997

THE USE OF RIVER FLOW DATA TO PREDICT LOW FLOWS AS AN AID TO TROUT FARM MANAGEMENT,
Anglian Water Authority (England).
J. W. East, and T. F. Colesc.
Fisheries Management, Vol 13, No 1, p 11-17, 1982. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Streamflow forecasting, Fish, *Low flow, Forecasting, *Trout, Hydrographs, Flow pattern, Springs.

A method for predicting streamflow in groundwater dominated streams allows prediction of low flows several months in advance so that trout farm management may be improved. Annual hydrographs for Belleau Springs, Lincolnshire, from summer and fall of 1971-77 were analyzed to prepare a master recession curve (discharges vs. time). The master recession curve was positioned over the annual hydrograph at the point where flow measurements began to decline, and the predicted values were read. Since it is assured that no runoff or recharge occurs, the estimates are conservative. (Cassar-FRC)
W82-06083

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,

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Utah Water Research Lab., Logan.
J. P. Riley, D. J. Chadwick, Jr., L. S. Dixon, L. D. James, and W. J. Grenney.
Water Resources Planning Series UWRL/P-82/02, March 1982. 194 p, 63 Fig, 31 Tab, 79 Ref, 5 Append. 14-06-D-7691.

Descriptors: *Salt uptake, *Salinity, Surface flow, *Overland flow, Model studies, Groundwater movement, Channel efflorescence, Irrigation effects, Simulation, Agricultural runoff, Mountains, Surface runoff, *Utah, *Salt River Basin.

Within the Price River valley, salt enters the river as it is carried by overland flow from natural areas, agricultural drainage, and groundwater inflow entering the stream from natural and man-caused sources. Field and laboratory measurements of process rates for runoff and salt movement were used to develop and calibrate a hydrosalinity model of outflows from the Price River Basin at Woodwide, Utah. The field measurements were specifically used to formulate a model for estimating surface flow in the Coal Creek Basin on the valley floor. The basin simulation assessment model (BSAM) was used to combine local flows and model total outflow from the Price River. As to field data, observed salt loading rates reached 518 lb/sq m daily, groundwater inflow declined steadily throughoout the summer but maintained constant salt concentrations, channel efflorescence varied more than 100 fold with the largest concentrations occurring in saturated bed material, and turbulent mixing and cyclic drying added to salt dissolution rates. Extrapolation of the results with the Coal Creek model showed only a very small percentage of the salt loading from the valley floor to originate from natural lands. BSAM showed average annual salt leaving the Basin at Woodside to be 190,000 tons, 114,000 coming from the mountain area and 76,000 from the valley floor. Of the valley floor contribution, only 3,500 tons are produced by surface runoff from nonirrigated areas. (Moore-SRC)
W82-06093

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
C. O. Ming, and G. H. Nelson.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $14.25, Microfiche $2.00. Geological Survey Open-File Report 81-1054, 1981. 4 Sheets.

Descriptors: *Floods, *Rainfall, *Flood peak, *Flood damage, Flash flood, Streamflow, Discharge measurement, High water mark, Rainfall intensity, Runoff, Historic floods, Hydrographs, Flood profiles, Flood plain management, Maps, *Alabama, Mobile.

Heavy and intense rainfall in the late evening and early morning hours, May 5 and 6, 1981, caused widespread flooding along streams and low-lying areas in the port city of Mobile, Ala. More than 12 inches of rain fell between 6 p.m. May 5, and 3 a.m. May 6. Damage caused by flooding was estimated by the Mobile Department of Public Works to be millions of dollars. Maximum water surface elevations on streams in the area were 2 to 3 feet higher than those that occurred during a similar flood in April 1980. The approximate extent of flooding delineated on maps using flood profiles obtained by field surveys will provide a basis for formulating effective flood plain zoning that could minimize existing and future flood problems. (USGS)
W82-06128

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06133

A STOCHASTIC STREAMFLOW MODEL OF THE PLATTE RIVER AT OVERTON, ODESSA, AND GRAND ISLAND, NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
A. V. Vecchia, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, Colo. 80225, Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1188, 1981. 42 p, 12 Fig, 10 Tab, 9 Ref.

Descriptors: *Model studies, *Streamflow, *Simulation analysis, *Flow characteristics, Evaluation, Monte Carlo method, Time series analysis, *Nebraska, Platte River, Overton, Odessa, Grand Island.

A stochastic model is developed to simulate flows for three seasons (September through February, March and April, May through August) at Overton, Odessa, and Grand Island, Nebraska on the Platte River. The model preserves the first and second order moment properties of the historical flow series, including significant autocorrelations within each station and cross-correlations between the stations. Higher order moments are preserved by a transformation technique that allows the residuals from the model to be approximately normal. An algorithm is given for simulation of combined-stations flows, and some simulations are carried out to determine the likelihood of specified flow shortages that could be detrimental to the wildlife habitat in the reach of the Platte River between Overton and Grand Island. (USGS)
W82-06139

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
L. C. Kjelstrom, and R. L. Moffatt.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $21.25, Microfiche $5.50. Geological Survey Open-File Report 81-909, September 1981. 99 p, 6 Fig, 3 Plates, 1 Tab.

Descriptors: *Flood forecasting, *Distribution patterns, *Frequency analysis, *Floods, Snowmelt, Rainstorms, Storm runoff, Regression analysis, Data collections, *Idaho, Snake River basin, Basin characteristics, Skew coefficients.

Skew coefficients for the log-Pearson type III distribution are generalized on the basis of some similarity of floods in the Snake River basin and other parts of Idaho. Generalized skew coefficients aid in shaping flood-frequency curves because skew coefficients computed from gaging stations having relatively short periods of peak flow records can be unreliable. Generalized skew coefficients can be obtained for a gaging station from one of three maps in this report. The map to be used depends on whether (1) snowmelt floods are domiant (generally when more than 20 percent of the drainage area is above 6,000 feet altitude), (2) rainstorm floods are dominant (generally when the mean altitude is less than 3,000 feet), or (3) either snowmelt or rainstorm floods can be the annual mixiumum discharge. For the latter case, frequency curves constructed using separate arrays of each type of runoff can be combined into one curve, which, for some stations, is significantly different than the frequency curve constructed using only annual maximum discharges. For 269 gaging stations, flood-frequency curves that include the generalized skew coefficients in the computation of the log-Pearson type III equation tend to fit the data better than previous analyses. Frequency curves for ungaged sites can be derived by estimating three statistics of the log-Pearson type III distribution. The mean and standard deviation of logarithms of annual maximum discharges are estimated by regression equations that use basin characteristics as independent variables. Skew coefficient estimates are the generalized skews. The log-Pearson type III equation is then applied with the three estimated statistics to compute the discharge at selected exceedance probabilities. Standard errors at the 2-percent exceedance probability range from 41 to 90 percent. (USGS)
W82-06142

EVALUATION OF GROUNDWATER RESOURCES IN TOKAR DELTA, SUDAN,
Khartoum Univ. (Sudan). Dept. of Geology.
M. T. Hussein.
Hydrological Sciences Bulletin, Vol 27, No 2, p 139-145, June, 1982. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Aquifers, *Water resources development, Tokar Delta, *Sudan, Deltas, Water quality, Water supply, Water supply development.

Groundwater resources in Tokar Delta are estimated. The delta is an area lying on the Sudanese coast of the Red Sea. Groundwater occurs in clastic sediments deposited in an arcuate prograding delta in which there are lagoons and barrier islands. It occurs at a depth of 7-9 meters in the upstream part of the delta, at 10-12 meters in the center and at 3-6 meters in the downstream portion of the delta. The general flow is paralled to the direction of the surface flow. Main recharge is from the waters of the Khor Baraka and other small ephemeral streams. The hydraulic gradient obtained averages 0.002. The wide range of transmissivity values reveals the heterogeneous nature of the sediments. The storage coefficient varies from about 0.003 in the lagoonal zones to 0.26 in bsrrier islands and upstream sediments. The hydrodynamic data are characteristic of an uncconfined aquifer in the upstream portion of the delta that fingers downstream in semi-confined conditions. As concerns water quality, Tokar Delta is divided into four zones: A fresh water zone, a transitional zone, a zone of sea water intrusion, and a low yield lagoonal zone with poor quality water. The quantity of water that can be safely exploited is 5,5200,000 cubic meters/year. (Baker-FRC)
W82-06197

GROUNDWATER AND MELTWATER IN THE SNOWMELT INDUCED RUNOFF,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Hydrological Sciences Bulletin, Vol 27, No 2, p 147-158, June, 1982. 8 Fig, 10 Ref.

Descriptors: *Groundwater, *Snowmelt, Streamflow, LRunoff, Melting, Basins, Catchment areas.

Various snowmelt-induced runoff processes are discussed. The influence of the diurnal snowmelt cycle on the runoff from basins of different type is analyzed. Through the analysis of measured hydrographs it is shown that conclusions about the origin of streamflow can be drawn from these anlyses. The study concludes that the low in small streams originates from groundwater and overland flow, with the ratio between the two different kinds of flow depending on basin characteristics. The character of the two flows is very different. The discharge in a stream in a basin which is dominated by overland flow follows the diurnal snowmelt fluctuations and is high from the first day of snowmelt. Streamflow originating from groundwater also reacts to snowmelt fluctuations, but the fluctuations are small, and the mean daily flow is increasing during the snowmelt period. One analyzed discharge hydrograph of a stream draining a small watershed has such a character that the streamflow in the first phase of the snowmelt period must mainly originate from overland flow from a large open meadow. In the final phase of the snowmelt period the streamflow is mostly due to groundwater flow recharged on a forested area, but overland flow also constitutes an important part of the total runoff. (Baker-FRC)
W82-06198

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,
Universidad Simon Bolivar, Caracas (Venequela)> Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, and L. A. Escobar.
Hydrological Sciences Bulletin, Vol 27, No 2, p 129-137, June, 1982. 5 Fig, 13 Ref.

Descriptors: *Drainage density, *Kinetics, Climates, Geomorphology, Basins, Hydrology, Streamflow, Runoff, Catchment areas.

The link is explored between the potential energy of the effective rainfall and the kinetic energy of the streamflow at the outlet of a basin. As water from rainfall flows downstream it will convert its potential energy into kinetic energy and friction loss or heat. The kinetic energy thus generated is the tool with which the flow can carve the channels forming the drainage network. Hence, the energy losses in a stream network should have a determining effect on the structure of the network. The lower the kinetic energy at the outlet for a given potential energy, the larger is the energy expenditure inside the basin and the larger one may expect to find the drainage density. This analysis shows that the drainage density cannot be analyzed on the basis of climate alone and that it is necessary to take into account the response characteristics of the basin in any spatial or climatic study of drainage densities. It appears that an energy expenditure framework may be a fruitful approach to providing a more concrete and objective understanding of climatic and geographical variation of the drainage densities of river basins. (Baker-FRC)
W82-06199

RELATIONSHIP BETWEEN THE YEARLY MAXIMA OF PEAK AND DAILY DISCHARGE FOR SOME BASINS IN TUSCANY,
Florence Univ. (Italy).
P. Canuti, and U. Moisello.
Hydrological Sciences Bulletin, Vol 27, No 2, p 111-128, June, 1982. 9 Fig, 2 Tab, 47 Ref.

Descriptors: *Basins, *Flood discharge, Discharge measurement, *Tuscany, Hydrology, Hydrologic models.

This paper deals with the estimation of the probability distribution of the yearly maximum of the peak discharge Q by means of the distribution of the maximum of the daily discharge q and the distribution of the ration R=Q/q. Data for the study related to a group of basins in Tuscany. It was found that the parameters of R can be expressed as a function of basin order, mean altitude, basin magnitude, basin relief, circularity ration and channel slope. In the case where basin order and magnitude, which are difficult to determine, should not be taken into account, the parameters of R can be expressed as a function of mean altitude, relief ratio, circularity ratio, length and basin relief. It is possible also to obtain satisfactory results by assigning constant values, equal to the mean values observed for the basins taken into consideration, to the parameters of R. Basin area did not appear to be one of the most strongly determining geomorphic parameters. However, the distribution of R is affected by the basin size through such parameters as basin magnitude or basin length. The parameters characterizing the distribution of Q can then be worked out as a function of the parameters of q and the parameters of R. Discharge values with pre-set return period obtained in this way show a satisfactory agreement with the values directly derived from a statistical analysis of the observed values; the errors are on the order of 20%. (Baker-FRC)
W82-06200

ROBUST FLOOD FREQUENCY MODELS,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 315-324, April, 1982. 1 Fig, 11 Tab, 28 Ref.

Descriptors: *Floods, *Flood frequency, *Mathematical models, *Simulation, *Estimation, Flood data, Statistical analysis, Probability distribution, Field investigations, Historical flood data.

The concept of a robust model is explored and possible robust flood frequency models are identified. A robust model is one which can produce reliable predictions. Such models possess at least two properties, resistance and efficiency. Resistance is the ability to estimate extreme events; it is desirable in situations where assumptions of the model are uncertain. In flood frequency models the normal distribution produces more resistant estimators than do other distributions. Efficiency refers to sampling variation. Efficiency can be improved by reformulating the model problem or by extending the data base; it is often improved by combining regional and site-specific data. Various simulation studies using Wakeby distributions were conducted. The resistances of various regional and site-specific estimators were examined. Results suggest that the two-parameter log normal distribution approximates the Wakeby distribution for return periods up to about 200 years; it is both most resistant and efficient. The gumbel procedures employing either maximum likelihood or probability-weighted moments displayed comparable resistance. It was observed that site-specific estimators become more preferable as site record length increases. (Titus-FRC)
W82-06319

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 1. DEVELOPMENT OF THE MODEL,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 383-398, April, 1982. 4 Fig, 25 Ref. OWRT B-112-IND.

Descriptors: *Flood peak, *Flooding, *Statistical analysis, *Mathematical models, *Seasonal variation, Discharge, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, Poisson ratio, Turkey.

The flood peak occurrences at a river cross section may be treated as a two-dimensional stochastic counting process in the time-discharge plane. Statistical and conceptual analyses were performed on the flood peaks data of the Karahacili station on the Goksu River in Turkey. A two-dimensional nonhomogeneous stochastic trigger model for the flood peaks is developed in terms of its univariate, bivariate, and multivariate probability generating functions. The first and second theoretical moments and the theoretical one- and two-dimensional probability mass functions of the flood peak counts in the time-discharge plane are derived from the probability generating functons. First, the flood trigger mechanism is modeled as a Poisson process, based on the assumption that flood peaks in non-overlapping time intervals are independent events. Then, flood peaks are modeled as a function of time, starting time, and discharge. Trigger models are appealing because they require minimal computation. (Titus-FRC)
W82-06325

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 2. APPLICATION OF THE MODEL TO THE FLOOD PEAKS OF GOKSU-KARAHACILI,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 399-411, April, 1982. 3 Tab, 9 Fig, 4 Ref. OWRT B-112-IND.

Descriptors: *Flooding, *Flood peak, *Statistical analysis, *Mathematical models, Discharge, Seasonal variation, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, *Xurkey, Goksu River, *Stochastic process.

The stochsatic trigger process is applied to the flood peaks data of the Karahacili gaging station on the Goksu River, Turkey, for several flood seasons. The flood peak process in each flood season is treated as a transient stochastic process which starts at the beginning of the season and ends at the end of the season. In the selection of the time boundaries of the flood seasons the basic criterion is that the stochastic structure of the flood peaks must be roughtly time-homogeneous within a flood season. Also, for statistical computation convenience the time sampling interval is 15 days, so the length of seasons should be a multiple of 15 days. For each season, the thoeretical two-cimensional probability mass function of the variable discharge exceedence level is calculated from the calibrated trigger model. Goodness of fit of the model is tested with the chi square criterion. In all of the seasons examined, the model passed the goodness of fit test at the 5 per cent significance level. This corresponds to a river stage that is 1 meter above the river bank stage on the Goksu. (Titus-FRC)
W82-06326

DISPERSION IN MOUNTAINOUS NATURAL STREAMS,
Sarajevo Univ. (Yugoslavia). Inst. of Water Resources Engineering.
H. Bajraktarevic-Dobran.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 502-514, June, 1982. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Streamflow, *Mountains, Model studies, Mathematical equations, *Turbulent flow, *Path of pollutants, Water pollution sources, *Dispersion.

The mixing of pollutant conservatives in natural, open turbulent mountainous streams was investigated. Considerable turbulency, with relatively limited width and corresponding spatial velocity distribution, make mountainous streams very suitable for the application of the longitudinal turbulent dispersion theory. Tracer study data are used to analyze a simple, relatively accurate and inexpensive method for the calculation of the longitudinal dispersion coefficient in natural open mountainous streams, based on the commonly observed flow parameters. Based on this study it appears that the most convenient methods today for calculating dispersion coefficients in natural and even nonuniform streams are Fischer's methods; the method of flow parameters and methods based on tracer study, the routing procedure, and the method of variance change. Fischer's method of flow parameters applied to mountainous streams gives dispersion coefficients with predicted accuracy within a factor of 4. It has been discovered that Fischer's other two methods, routing procedure and variance change, when used for mountainous streams also yield the predicted accuracy. Calculating the adjusted time scale by a new expression for characteristic length was seen to be convenient and to yield good results for winding and nonuniform streams, which is convenient for natural mountainous streams as well. If there are a number of mainstreams in a cross section, this should be considered when establishing a time scale. (Baker-FRC)
W82-06357

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,
New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2A.
W82-06384

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze, and H. Arnold.
Report, 1980. 137 p, 3 Fig, 9 Tab, 23 Ref, 5 Append.

Descriptors: *Streamflow, *Computer programs, *Rainfall-runoff relationships, *Hydrologic data collections, *Digital computers, Rainfall intensity, Runoff, Flow rates, Flow measurement, Flow discharge, Flow, Precipitation intensity, Rainfall index, Data collections, Data interpretation, Hydrologic data, Computer models.

Procedures are described for the reduction of data contained on rainfall and streamflow recorder charts, and subsequent routine rainfall/streamflow data analyses. Flow charts and the computer program listings concerning data analyses are present-

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ed. Rainfall records reduced by the break-point digitizing procedure are processed in monthly data batches by the program RAINX which outputs one or more of six options (a master file; daily, hourly, and quarter-hourly rainfall summaries; the 24-hour rainfall distributiion; and extreme rainfall intensities). The six options are described, followed by a review of the RAINX program structure as an introduction to the detailed flow charts and program listings of RAINX and its subroutines. Streamflow records digitized by the break-point procedure are processed by the program RUNOF which out-puts one or more of three options (a master file; storm hydrograph data; and a daily summary of streamflow variables). As with RAINX, the output options and a review of the RUNOF program structure, flow charts, program listings and subroutines are described. The digitizing programs, CDPROC, is also delineated, along with its program listing. While the three computer programs are already versatile in their present forms, their refinements based on experience and specific applications are an ongoing process. (Zielinski-MAXIMA)
W82-06386

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,
London Coll. (New Zealand). Dept. of Agricultural Engineering.
T. R. H. Davies.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 343-360, March, 1982. 6 Fig, 42 Ref.

Descriptors: *Classification, *Flow channels, *Streambeds, Alluvial channels, Physical properties, Sedimentation, Erosion, Streamflow, Low flow, Bedforms, Dunes, Ripple marks, Sedimentary structures.

There is at present no generally accepted explanation for the occurrence and behavior of lower flow regime bedforms, in spite of the many field, laboratory, and theoretical investigations addressing this problem. This lack of understanding of bedform processes presents a major obstacle to the development of rational solutions for sediment problems. The use of systems of bedform classification which are qualitative in nature has thwarted efforts to test quantitative theories of bedform behavior. A more quantitative basis for the description of bedforms, which is based on consideration of the effect of water flow on the shape and size of bedforms, is suggested. This classification system identifies three orders of bedform size (Small, medium, and large) and three bedform shapes (Sharp-crested, flat-crested, and flat), which give rise to seven possible types of bedform. The predictions of this analysis were found to be in agreement with data from a variety of sources relating bedform characteristics to mean flow depth and velocity. This classification system appears to provide a consistent framework by means of which bedforms in widely different circumstances can be interrelated. The system also suggests logical explanations for several previously puzzling aspects of bedform behavior, such as ripples on dunes. Further research is needed to develop more precise divisions among the seven forms and to test critically, and perhaps modify, previously developed models of bedform behavior. (Carroll-FRC)
W82-06421

ACCURACY CRITERIA IN DIFFUSION ROUTING,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-06423

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06427

CARRYING CAPACITY OF FLOOD PLAINS,
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik, and M. Demissie.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 443-452, March, 1982. 6 Fig, 21 Ref.

Descriptors: *Flood plains, *Carrying capacity, *Flow channels, Flood flows, Streamflow, Flood discharge, Flood frequency.

Field measurements during floods in several natural channels were analyzed to determine the distribution of flow in the main channel and in the flood plains. The carrying capacity of the flood plains was found to vary from a few percent to more than 80% of the total flow for the floods analyzed. Major factors determining the carrying capacity of the flood plains were the size, shape or form, width, depth, and nature of the flood plains and the main stream and the frequency of the flood event. The carrying capacity of the flood plain was found to increase with increases in the return period of the flood event. The flood plains act as a combination of conveyance channel and storage reservoir during low flood events. However, the flood plain and the main channel appear to behave as a single unit carrying a proportionate share of the discharge during flood events with return periods of 40 years or more. The character of the flood plains appears to change from a storage channel to a conveyance channel as flood events increase in magnitude. (Carroll-FRC)
W82-06428

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr., G. L. Achtemeier, S. D. Hilberg, H. V. Knapp, and R. D. Olson.
Illinois Department of Energy and Natural Resources, Report of Investigation No 102, 1982. 13 p, 39 Fig, 28 Tab, 46 Ref.

Descriptors: *Drought, *Water shortage, *Climatology, *Water levels, *Hydrology, Climactic data, Water costs, Evapotranspiration, Weather, Groundwater, Precipitation, Streamflow, Water supply development, Water supply systems, Weather data collections, Planning.

This report focuses on the hydrlogic, meteorologic, and climatological aspects of the 1980-1981 drought. An important goal of the study was to provide information necessary for future institutional planning and actions to handle future Illinois droughts. This drought, the severest since the early 1950s, was most intense in the southwestern and extreme southern sections of Illinois. These areas had the lowest precipitation, highest temperatures, and greatest departures from normal wind speeds, which produced the state's greatest evaporation and transportation values and subsequent low streamflows and groundwater deficiencies. Five general societal and economic impacts were revealed: 1) increased costs of water and water-related activities, decreased crop yields and land values, and increased costs to ship farm products; 2) increased energy consumption and adverse effects on the area's natural resources; 3) effects on human behavior, i.e., anxiety about finding and conserving water, and a reduction in recreational activities; 4) additional direct and indirect costs to government; and 5) some benefits, i.e., improved and/or larger and better water supply systems. This research has lead to four general recommendations. The first is to develop better informed and organized local and state programs for addressing droughts. The second recommendation is to renovate older water supply systems. The third relates to water conservation, water reuse, and higher water prices. The last recommendation is to develop and use new technologies to help increase water supplies and to aid in better water management. (Atkins-Omniplan)
W82-06523

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,
Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
B. P. Sangal.
National Hydrology Research Institute, NHRI Paper No 16, IWD Technical Bulletin No 122, 1981. 242 p, 6 Fig, 7 Tab, 5 Ref.

Descriptors: *Mean daily flows, *Peak flow, *Flow rates, *Fuller's method, *Langbein's method, *Ontario, Streamflow foredasting, Hydrographs, *Data collections, Statistical Analysis.

A practical method has been suggested for estimating peak flow. The method uses variables that are the mean daily flows of three consecutive days, with the maximum mean daily flow occupying the middle position. A parameter, the value of which lies etween zero and two, is designated as base factor K and has a governing influence on the estimated peak. The predicting formula employed assumes that the K value is equal to one. The method has been applied to streams in Ontario, involving a total of 387 stations equipped with recording gauges, the drainage areas of which vary from less than 1 sq km to more than 100 000 sq km. The number of instantaneous peak data available was 3946 in the period of record ending in 1979. About 57% of the predicted peaks lie within plus or minus 10% and about 79%, within plus or minus 20% of the actual values. About 62% of the peaks have been overpredicted. The parameter K must be estimated for rainfall floods occurring on small streams; its value will generally be less than one for such cases. Some methods are suggested for its estimation. (WATDOC)
W82-06568

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,
Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5B.
W82-06569

CALIBRATING A MOUNTAIN WATERSHED IN WYOMING,
Wisconsin Univ., Stevens Point. Coll. of Natural Resources.
N. E. Spangenberg.
Water Resources Bulletin, Vol 18, No 1 p 133-134, February, 1982. 2 Tab, 5 Ref.

Descriptors: *Calibrations, *Watersheds, *Mountains, Regression analysis, Mathematical studies, Streamflow, Small watersheds, *Wyoming.

Although all investigators who have studied the problem of watershed calibration agree that a minimum pretreatment period is necessary for reliable analysis, in some cases management plans necessitate the use of very sparse existing data as pretreatment information. The calibration of a mountain watershed in Wyoming under such conditions is reported. Imminent timber harvesting forced calibration on the basis of stream flow records for a 5-year period, precipitation data for 10-year period, and stream flow data for another watershed for a 15-year period. Regression equations were tested using the noncentral 't' and associated power graphs to calculate the probabilities of detecting a real difference of 15% of the mean annual flow given the pre and post treatment time periods likely to be available during management. The data suggest that if the Walnut Gulch trapezoidal flume previously used to measure the basin can be reactivated, and if stream flow measured values after treatment are consistent with values before treaatment, it will be possible to detect a 15% difference in flow. The longer the calibration period, the higher the probability of detecting a real difference in flow. (Carroll-FRC)
W82-06583

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06671

Group 2E—Streamflow and Runoff

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,
Geological Survey, MS. Water Resources Div.
L. B. House.
Geological Survey Open-File Report 81-1192 (WRI), December 1981. 25 p, 4 Fig, 1 Plate, 10 Tab, 5 Ref.

Descriptors: *Streamflow, *Water quality, *Preimpoundment, *Postimpoundment, Reservoirs, Water temperature, Dissolved oxygen, Model studies, Aquatic weeds, Nuisance algae, Chemical analysis, *Wisconsin, Augusta, Bridge Creek watershed.

This study documents streamflow, temperature, and water-quality conditions of a small stream and evaluates the potential effects of a proposed small shallow impoundment. The study was made in cooperation with the Wisconsin Department of Natural Resources. Streamflow and water-quality data were obtained for the 1980 water years. The average streamflow was 45.5 cubic feet per second. The average summer water temperature was 21.0 C, and the average summer dissolved-oxygen concentration was 7.1 milligrams per liter. Computer models were used to simulate the effects of the proposed impoundment on downstream temperature and dissolved oxygen. The simulated average summer downstream temperature rose to 22.5 with a surface-level outlet from the impoundment, and 21.9 C with a bottom-draw outlet. Dissolved oxygen exceeded 6.0 milligrams per liter in both cases. (USGS)
W82-06677

EFFECTS OF FLOODING UPON WOODY VEGETATION ALONG PARTS OF THE POTOMAC RIVER FLOOD PLAIN,
Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Available from Distr. Branch, USGS 604 S. Pickett St. Alexandria, VA 22304 $3.50. Geological Survey Professional Paper 1206, 1982. 21 p, 18 Fig, 7 Tab, 27 Ref.

Descriptors: *Flood plains, *Flood damage, *Vegetation regrowth, *Revegetation, Floods, Flooding, Historic floods, Channel flow, Flood peak, Flood frequency, Flood recurrence interval, *Potomac river, Washington DC, Hurricane Agnes.

A two-part study along the Potomac River flood plain near Washington, D.C., was undertaken to investigate the effects of flooding upon woody vegetation. Floods abrade bark, damage branches and canopies, and often uproot trees. The first study was of vegetation in five monumented floodplain plots which differed in the frequency and severity of floodflow over a 10-year period. Basal area and survival of trees appears to be related to velocity of floodflow, which in turn is related to flood magnitude and channel shape. However, the effects of flooding also depend on the nature of the flood-plain surface and size and growth habit of vegetation. In the second study, a catastrophic flood after Hurricane Agnes in June 1972 was found to cause large-scale changes in the age, form, and species composition of flood-plain forest below Great Falls, Va. The impact of the flood depended primarily on the flow regime of the river; destruction was greatest in areas exposed to the maximum flood foce, and minimal at sheltered locations. Age determinations from dead trunks and surviving trees suggest that most trees in severely damaged areas started to grow since the last great flood, which occurred in 1952. Trees along sheltered reaches survived several previous catastrophic floods. In addition, species varied in ability to withstand damage from the Hurricane Agnes flood. Least likely to recover were species growing on infrequently flooded surfaces, which may explain, in part, their absence at lower flood-plain elevations. (USGS)
W82-06683

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. Slingerland.
Geology, Vol 9, No 10, 1981, p 491-493. 1 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Hydraulic geometry, *Friction, *Systems analysis, Roughness coefficient, Equilibrium, Stability analysis, Velocity, Bedload, Bedload discharge.

An example of how stability analysis can be used to analyze partially specified geologic systems is presented. A partially specified system is one in which the direction of feedback is known, but the exact functional relationships are not. The example presented is an analysis of the response of a stream's hydraulic geometry to disturbance. Five variables with various positive and negative feedback loops specify the system. The variables include stream velocity, friction, hydraulic radius, bedload transport rate, and bed slope. The system's response to perturbation is described by analyzing the eigenvalues derived from the coefficient matrix of the system equations evaluated near an equilibrium point. When applied to the example, this process predicts that the stream is metastable provided that the rates of change of the friction factor, hydraulic radius, and slope are highest, intermediate, and lowest, respectively. Streams violating this ranking are unstable. (Titus-FRC)
W82-06717

MICROBIAL DYNAMICS OF AN EPILITHIC MAT COMMUNITY IN A HIGH ALPINE STREAM,
Montana State Univ., Bozeman. Dept. of Microbiology.
T. K. Haack, and G. A. McFeters.
Applied and Environmental Microbiology, Vol 43, No 3, p 702-707, March, 1982. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Microbiological studies, *Alpine regions, Cold regions, Mountains, Orography, Streams, Bacteria, Algae, Lakes.

The seasonal dynamics of an epilithic algal-bacterial mat community are described, the trophic complexity of which was greatly reduced because of the highly oligotrophic nature of the stream. The study site was the outlet stream of Pine Creek Lake, an alpine cirque lake situated at 2,740 meters in the Absaroka mountains. The lake is fed primarily from springs and snow runoff and is surrounded almost entirely by rock, with little vegetation present in the drainage area. The slippery surface properties of the mat community suggested that extracellular polymeric material was one major component. The mat consisted primarily of diatoms, bacteria, and some filamentous algal forms, all embedded with a dense gelatinous matrix. Water temperature rose from 1.5 to 13 degrees C during the study period. Due to the short duration of warm weather, the mat was active only a few months out of the year. The growth of the phototrophic community peaked at the same time of year as did stream water temperature. All aspects of bacterial heterotrophic activity showed dramatic increases with seasonal progression, indicating maximal uptake rate of a given substrate by the population. The heterotrophic bacterial population in the mat responded to a decline in the phototrophic community with higher catabolic rates. These rates may have increased in response to quantitative or compositional changes in the soluble organic compounds excreted by the phototrophs as their population was waning. However, bacterial consumption rates were highest when primary productivity was lowest, indicating that bacteria were substrate limited at this time of the season with respect to algal extracellular products. It is likely therefore that the accelerated bacterial catabolic activity was triggered in response to an accumulation of algal lysis products. (Baker-FRC)
W82-06729

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 4A.
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 4A.
W82-06855

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,
Geological Survey, Sacramento, Calif. Water Resources Division.
For primary bibliographic entry see Field 4A.
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,
Geological Survey, Denver, Colo. Water Resources Division.
T. R. Eschner, R. F. Hadley, and K. D. Crowley.
Open-File Report 81-1125, 1981. 57 p. 14 Fig, 5 Tab, 61 Ref.

Descriptors: *Surface water, *Streamflow, *Alluvial channels, *Channel morphology, Water use, Vegetation effects, Flood peak, Flow characteristics, Flow duration, Low flow, Wildlife habitats, *Colorado, Nebraska, Platte River basin.

The channels of the South Platte River in Colorado and Nebraska and the North Platte and Platte Rivers in Nebraska have undergone major changes in hydrologic regime and morphology since 1860. These changes are attributed to agricultural, municipal, and industrial water use. Diversion and storage of water have changed streamflow patterns throughout the basin. At some stations, significant changes in flood peaks, annual mean discharges, and shapes of flow-duration curves have been observed. Changes in streamflow patterns are manifested by changes in morphology of channels of the Platte River. Prior to water development in the 19th century, the Platte was a wide (2 kilometers), shallow (1.8 to 2.4 meters) river characterized by bankfull spring flows and low summer flows. The width of the Platte River in 1979 ranged from 8 to 92 percent of the channel width in 1860, increasing in a downstream direction. Above the confluence with the Loup River, overbank flows evidently have become more common. Moreover, the annual number of low flow days has increased and the days of no flow have decreased giving the channels a more perennial character. Width reduction has occurred by progressive encroachment of vegetation and consequent vertical and horizontal accretion on sand bars in the channel. (USGS)
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-06947

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 8B.
W82-06948

2F. Groundwater

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
V. V. Palciauskas, and P. A. Domenico.

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Water Resources Research, Vol 18, No 2, p 281-290, April, 1982. 5 Tab, 22 Ref.

Descriptors: *Rock mechanics, *Radioactive waste disposal, *Groundwater management, *Thermal pollutiion, *Geologic fractures, Waste management, Resources management, Rock properties, Fluid mechanics, Radioactive wastes, Thermal conductivity, Heat transfer, Thermal expansion.

The fluid pressure and mechanical response of a potential nuclear waste repository rock to heating was characterized by isothermal parameters of the classic stress-strain theory for a porous medium plus some nonisothermal parameters describing the fluid, solid, and pore volume expansivities. By formulating the fluid response within the limits of drained and undrained behavior, the isothermal coefficients may be described in terms of more easily interpretable parameters. The ideal repository for nuclear wastes would appear to favor an undrained response within the isolated pores and cracks of a fracture rock medium. Cases of fluid pressure increases in excess of temperature-induced increases under in situ stress, elastic strain and the potential for inelastic crack propagation, and porosity-permeability augmentation are presented. These examples illustrate an irreversible effect of temperature due to the differential thermal expansion of the composite mineral grains and the generation of new grain boundaries. During such a heating event, the increase in porosity may be calculated and is empirically related to increases in permeability. (Geiger-FRC)
W82-05904

INFILTRATION RATES OF RAINWATERS IN SRI LANKA MEASURED BY USING TRITIUM TRACER,
Sri Lanka Univ., Colombo.
J. K. Dharmasiri, K. G. Dharmawardena, M. W. P. Wijesinghe, P. Thiranagama, and I. D. T. De Mel.
Nordic Hydrology, Vol 13, No 1, p 13-27, 1982. 10 Fig, 3 Tab, 11 Ref.

Descriptors: *Radioactive tracers, *Tritium, *Natural recharge, *Rainfall infiltration, *Rainfall-runoff relationships. Tracers, Radioisotopes, Recharge, Infiltration rate, Groundwater recharge, Soil water, Moisture profiles, Geohydrology, Groundwater hydrology, *Sri Lanka.

Some experiments were conducted on top soil of Sri Lanka to study the infiltration rates of rainfall using artificial tritium as a tracer. For two well-established aquifers, Mannar and Vanathavillu, the recharge of groundwater is close to 30%, while the infltration rate is much higher. Fractional recharge values at Madhu Road sites vary from 15 to 32%. Moisture movement in this area resembles piston flow. In the central highland sections which are covered with fractured rocks overlain by only a few meters of top soil, the rate of infiltration is very high. (Geiger-FRC)
W82-05941

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,
Komenskeho Univ., Bratislava (Czechoslovakia).
I. Mucha, and H. Kaergaard.
Nordic Hydrology, Vol 13, No 1, p 27-38, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Aquifer systems, *Aquifer testing, *Leaky aquifers, *Aquitards, *Drawdown, *Pumping, Model studies, Numerical analysis, Mathematical studies, Confined aquifers, Groundwater movement, Pump wells, Test wells, Aquicludes.

A numerical model was devised for computing drawdowns (resulting from pumping a single well) anywhere in a multiaquifer/aquitard system. Since the model cannot handle inhomogeneities in horizontal directions, it is of a radial, symmetric type. The model has proven useful in studying drawdown evolutions during aquifer tests in stratified geohydrologic systems. It was designed to compute the effects of stratification on the results of pumping tests. In order to understand the behavior of the model, drawdowns in a hypothetical system were computed and compared with standard aquifer test formulas. Application of the model in interpreting two previously reported aquifer tests for Horsens Municipal Water Supply and the Torkildstrup-Lillebraende Waterworks of Denmark showed good agreement of simulated and field results. The model has been especially helpful in revealing the limitations involved with using standard aquifer test formulas in such systems. (Geiger-FRC)
W82-05943

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, and P. Fritz.
Canadian Journal of Earth Sciences, Vol 19, No 4, p 645-661, April, 1982. 8 Fig, 4 Tab, 44 Ref.

Descriptors: *Groundwater, *Chemical analysis, Sudbury Basin, Dating, *Ontario, Canada, Water analysis, Calcium, Sulfates, Sodium, Chlorides, Meteoric water.

A detailed survey was undertaken in 1979-1980 to evaluate the occurrence, chemistry, origin, and genesis of saline groundwaters across the Canadian Shield, with early work focusing on the chemical and isotopic compositions of deep groundwaters from the Sudbury Basin. The Basin is a elliptical body about 60 km long and 30 km across with an east-northeast trending long axis. Several large faults, which extend to considerable depth, intersect many of the rock units along the north edge of the basin. It appears that the faults and dikes, particularly on the north side of the basin, play a major role in the transport and storage of groundwaters at depth. Groundwater samples were obtained from Falconbridge's Fraser, North, and Lockerby mines and INCO's Copper Cliff South and Garson mines. Two very distinctive groundwater types were found. Above 914 meters the waters are of meteoric origin, showing a gradual increase in dissolved load with depth, and seldom exceeded 5000 mg/liter salt concentration. With increasing depth these waters usually showed considerable increase in sodium, calcium, chloride and sulfate, while decreasing in concentrations of magnesium, potassium, and carbonate. The water with a meteoric origin has a considerable volume less than 30 years in age. Highly saline waters and brines were encountered below 914 meters. The brines appear to represent very old, stagnant groundwaters which may have undergone prolonged chemical and isotopic alteration since their original emplacement. (Baker-FRC)
W82-05990

DEVELOPMENT OF PREDICTION EQUATIONS FOR A PHREATIC AQUIFER IN RESPONSE TO INFILTRATION: DIMENSIONAL ANALYSIS,
Mississippi Univ., Oxford. Dept. of Civil Engineering.
S.-Y. Liong, and D. G. DeCoursey.
Water Resources Bulletin, Vol 18, No 2, p 307-310, April, 1982. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Aquifers, *Infiltration, *Dimensional analysis, Subsurface flow, Phreatic aquifers, Streamflow, Prediction, Unconfined aquifers, Groundwater movement.

Dimensional analysis was used to study the response of a phreatic aquifer to infiltration. Relationships between dependent and independent variables were developed in this preliminary work, which provided an understanding of the dependence of subsurface contributions to streamflow on the dimensions of the flow domain, soil properties, infiltration rate and duration, and the initial hydraulic gradient of the water table. This information will be used to develop prediction equations. (Cassar-FRC)
W82-06066

HELIUM ISOTOPES IN GEOTHERMAL SYSTEMS: ICELAND, THE GEYSERS, RAFT RIVER AND STEAMBOAT SPRINGS,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and W. J. Jenkins.
Geochimica et Cosmochimica Acta, Vol 46, No 5, p 739-748, May, 1982. 1 Fig, 6 Tab, 58 Ref.

Descriptors: Geothermal resources, *Helium, Isotope, *Iceland, Groundwater, *Geothermal studies, *Hawaii, *The Geysers, *Raft River, *Steamboat springs, Volcanoes, Volcanic springs.

Helium isotope ratios can be used to evaluate a variety of geologic and hydrologic problems. The helium isotope composition of geothermal fluids is used to evaluate the local tectonic environment in the light of possible overprint mechanisms and to infer a probable source for the thermal anomaly. Geothermal fluids studied were from Iceland, The Geysers, Raft River, Steamboat Springs, and Hawaii. The helium isotope ratios were interpreted in terms of the processes which supply helium in distinct isotopic ratios and in terms of processes which can change the isotopic ratio. Iceland was found to be an area of hot spot magmatic helium, implying an active volcanic source, although data are suggestive of high temperature weathering release of crustal helium incorporated in the geothermal fluids. According to a comparison with fumarolic gases from Hawaii and Juan De Fuca and Cayman Trench Basaltic glass samples, The Geysers contains mid-ocean ridge type magmatic helium, again implying an active volcanic source, possibly a leaky transform related to the San Andreas Fault System. Raft River contains only crustal helium, indicating no active volcanic sources. Steamboat Springs helium isotope ratios are distinctly less than typical plate margin volcanics but must still have a magmatic source. A preliminary assessment of the cause for this low ratio is made, assuming an aging magma source. (Baker-FRC)
W82-06085

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06131

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06135

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06138

GROUND-WATER HYDROLOGY OF STRIP-MINE AREAS IN EASTERN OHIO (CONDITIONS DURING MINING OF TWO WATERSHEDS IN COSHOCTON AND MUSKINGUM COUNTIES),
Geological Survey, Columbus, OH. Water Resources Div.
J. O. Helgesen, and A. C. Razem.
Geological Survey Open-File Report 81-913 (WRI), 1981. 25 p, 14 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater, *Strip mines, *Small watersheds, *Coal mining, Spoil banks, Aquifers, Groundwater movement, Sedimentary rocks, Perched water, Observation wells, Water level, Base flow, Model studies, Water quality, Chemical analysis, Data collections, Hydrographs, *Ohio, Coshocton County, Muskingum County.

Ground-water conditions during coal strip-mining in two small watersheds are described as part of an ongoing study of effects of mining on hydrologic systems. Each watershed was underlain by stratified sedimentary rocks containing two perched aquifers above clays which underlaid the major coal seams. Mining involved removing the overburden rocks, including the top aquifer, stripping the top coal seam, and recontouring the overburden spoils to the approximate premining shape of the watershed. Water-levels in the top aquifer declined as mining neared the watersheds, but destruction of observation wells precluded a record of the decline during mining of the watersheds. Depletion of the top aquifer was reflected in stream base flow, which was reduced and more highly mineralized after mining. Initial saturated thickness of replaced overburden spoils ranged from 0 to 4 feet, based on data from observation wells installed immediately after reclamation. Down-hole specific conductance measurements of water in the spoils suggest the presence of more highly mineralized water than that in the premining top aquifer. No immediate significant effects of mining are evident on groundwater levels or quality beneath the stripped coal. (USGS)
W82-06141

CHLORIDE ION CONCENTRATIONS AS AN AID TO ESTIMATING RECHARGE TO THE WOBURN,
National College of Agricultural Engineering, Silsoe (England).
W. M. Irving.
Quarterly Journal of Engineering Geology, Vol 15, No 1, p 47-54, 1982. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Natural recharge, *Groundwater recharge, *Clays, Mathematical studies, *Chlorine, *Groundwater hydrology, Recharge, Drawdown, *Chlorides, Saline water, Evapotranspiration, Geohydrology, Groundwater movement, Surface runoff, *England, Woburn Sands.

The principal representative of the Lower Greensand on the north side of the London basin is the Woburn Sands, which outcrop in Bedfordshire and Cambridgeshire. Where the outcrop is covered with till, recharge waters contain higher levels of chloride than waters recharged in drift-free areas. This was attributed to higher evapotranspiration rates where the soil is underlain by boulder clay. Localized increases in chloride concentrations ere also noted due to indirect recharge from influent streams and mizing with old saline waters. The average annual natural direct recharge for untilled areas agreed closely with published figures determined by Penman and Grindley's equations. These equations may be used to calculate approximate values for recharge through boulder clay when losses to surface water as runoff and inteflow are taken into account. The amount of indirect recharge from influent streams is also calculated. (Geiger-FRC)
W82-06234

STEADY STATE PERCHED GROUNDWATER MOUNDS ON THICK SUBLAYERS,
California State Univ., Fullerton. Dept. of Civil Engineering.
R. R. Brock.
Water Resources Research, Vol 18, No 2, p 376-382, April, 1982. 2 Tab, 6 Fig, 5 Ref.

Descriptors: *Groundwater, *Permeability, *Perched groundwater, *Aquifers, *Mathematical models, Darcy's law, Profiles, Water table profiles, Recharge basins, Estimating equations, Statistical analysis, Model studies, Groundwater recharge.

Perched groundwater mounds that develop beneath a strip recharge basin are considered using the potential theory for a saturated flow. The mounds are assumed to develop upon an aquitard or sublayer whose thickness is large enough so that the vertical velocity at the base of the mound does not vary with distance from the centerline of the basin. A finite difference technique was used to solve the potential theory, and 20 mound profiles were determined for various permeability ratios and recharge rates. It is found that for a sufficiently large value of the permeability ratio, the Dupuit-Forchheimer theory will accurately predict mound thickness. For smaller values, the equipotential theory must be used. (Titus-FRC)
W82-06317

EVALUATION OF THE GROUNDWATER RESOURCES OF THE AGAG BASIN, SAIPAN,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers.
Technical Report No 31, November 1981. 82 p, 12 Fig, 6 Tab, 20 Ref, 2 Append. S 80-161.

Descriptors: *Groundwater availability, *Groundwater basins, *Groundwater depletion, *Recharge, *Water management, Pumping tests, Permeability, Water level, Water table fluctuation, Water table profiles, Aquifers, Driling samples, Driller logs, Head loss, Monitoring, Water deficit.

The Agag groundwater basin has long been a reliable source of high-quality water. Because little was known about the basin, this study was undertaken to investigate the hydrogeological characteristics of the basin to determine the optimal or sustained yield of the aquifer. Exploratory drilling, water-level monitoring, and analyses of past and current field data were employed. The basin is a three-dimensional mosaic of interbedded and interfingered units of the Tagpochau limestone of Miocene age. Pump-test analyses put the permeability range of the marly facies between 25-70 ft/day. A strong correlation was found between water-table fluctuations and seasonal rainfall, with a ten foot variance between wet and dry seasons not unusual. Water-table data plotted against time (since 1973) indicate a decline of 1.25 ft/yr with the overdraft occurring in the dry season. Annual recharge is about 40-to-46 percent of the yearly rainfall and occurs during wet-season months; none occurs in the dry months. Because recharge is seasonal, two values of sustained yield have been determined: 300,000 gpd in the dry season (January-June) and 600,000 gpd in the wet season. Proper management of the basin requires a stable water-table level so that wet-season recharge will replenish the stored groundwater removed during the dry-season production period. Recommendations include moving one well to overcome interference from other wells, continuation of water-level monitoring, installing piezometers in all production wells, and implementing a two-season pumping schedule. (Atkins-Omniplan)
W82-06524

CALCULATIONS OF THE CAPACITY OF WATER INTAKES WITH CONSIDERATION OF GROUNDWATER LEAKAGE THROUGH STEEPLY DIPPING, POORLY PERMEABLE DEPOSITS,
Moscow Combined Geological and Geophysical Expedition (USSR).
A. M. Prosekov.
Water Resources, Vol 8, No 3, p 336-340, May/June, 1981. 2 Fig, 3 Ref. Translated from Vodnye Resursy, No 3, p 176-181, May/June, 1981.

Descriptors: *Well yield, *Seepage, *Groundwater availability, *Artesian capacity, Geohydrology, Aquifer systems, Capacity, Permeability, Model studies, Numerical analysis, Oka-Tsna arch, Groundwater potential, Mathematical models, Hydrodynamics, *USSR.

The capacity of groundwater intake, considering leakage of groundwater through steeply dipping, poorly permeable deposits, was calculated for the 200 km long crest part of the Oka-Tsna arch, a submeridional positive tectonic structure in the region of the Moscow artesian basins. A linear row of wells at the foot of the arch along its axis intercepts one aquifer, separated from a second aquifer by a poorly permeable clay layer, but receiving some seepage. The results of the calculations more reliably reflected natural conditions than a model with an impermeable boundary or an inhomogeneous bed. (Cassar-FRC)
W82-06617

LINEAMENTS AND FRACTURE TRACES, JENNINGS COUNTY AND JEFFERSON PROVING GROUND, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
T. K. Greeman.
Geological Survey Open-File Report 81-1120, December 1981. 17 p, 3 Fig, 1 Plate, 16 Ref.

Descriptors: *Geological fractures, *Groundwater availability, *Water demand, *Aquifer characteristics, Wells, Drilling, Water yeild, Bedrock, Groundwater movement, Potential water supply, Maps, *Indiana, Jennings County, Jefferson Proving Ground, Lineaments, Fracture traces.

Location of vertical or near-vertical bedrock fractures observed throughout the study area in Indiana are shown on a lineament and fracture trace map. Wells drilled on these mapped features may yield adequate supplies for domestic use. Large yields may be available in southwest Jennings County. Two nearly horizontal sequences of middle-Paleozic limestone and dolomite, separated by a thin discontinuous shale unit, constitute the prinicpal aquifer. Many wells in this aquifer fail to supply household needs, whereas others supply several households. All wells in the aquifer have been located for the owners' convenience and are randomly located in relation to lineaments and fracture traces. Pleistocene drift, averaging 25-30 feet in thickness, did not restict lineament nad fracture-trace mapping. Well placement is important in this area, as fractures are a principal source of water to wells. In fractured bedrock areas, the most productive wells are at mapped lineament or fracture-trace intersections and at the lowest local altitude. Use of the lineament and fracture-trace map will not guarantee a sufficient ground-water supply, but it will minimize the chance of drilling an inadequate well. (USGS)
W82-06675

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06676

SUMMARY OF HYDROLOGIC TESTING IN TERTIARY LIMESTONE AQUIFER, TENNECO OFFSHORE EXPLORATORY WELL--ATLANTIC OCS, LEASE-BLOCK 427 (JACKSONVILLE NH 17-5),
Geological Survey, Atlanta, GA. Water Resources Div.
R. H. Johnston, P. W. Bush, R. E. Krause, J. A. Miller, and C. L. Sprinkle.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2180, 1982. 15 p, 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater, *Test wells, *Confined aquifers, *Geochemistry, Geohydrology, Geohydrologic units, Limestone, Drilling, Continental shelf, Saline-freshwater interfaces, Data collections, *Atlantic outer-continental shelf, Drill-stem tests.

A summary of hydrologic testing in an offshore oil-test well drilled for Tenneco, Inc. 55 miles east of Fernandina Beach, Fla., is presented. The interval tested (1,050 to 1,070 feet below sea level) is in a calcarenite that is equivalent to the Ocala Limestone (late Eocene) of onshore Florida and South Georgia. Onshore the Ocala forms the highly productive Tertiary limestone aquifer system of the southeastern United States. Pressure-head measurements indicate an equivalent freshwater head of 24 to 29 feet above sea level. This pressure-head measurement and an earlier one made in the nearby JOIDES J-1 hole are the only hydraulic head determinations to date in the offshore extensions of any of the aquifers underlying the Atlantic Coastal Plain. The drill-stem test recovered water samples containing about 7,000 milligrams per liter chloride. However, seawater used in the drilling process apparently contaminated the samples and the

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formation water is considered slightly fresher. The head and salinity data from the Tenneco well suggest that the sampled interval lies in the transition zone between fresh and seawater in the limestone aquifer. These data, when viewed with similar data from JOIDES J-1, show the transition zone to the slope very slightly landward. Heads at both wells are compatible with the onshore flow system as it existed prior to development. (USGS)
W82-06685

GROUND WATER IN THE PIEDMONT UPLAND OF CENTRAL MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
C. A. Richardson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2077, 1982. 42 p, 7 Fig, 7 Tab, 28 Ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater availability, *Geohydrology, Aquifer characteristics, Water table, Wells, Water yield, Water quality, Water use, Water supply, *Maryland, Maryland Piedmont.

Aquifers in a 130-square-mile area of the central Maryland and Piedmont, are shown to be the sole or principal source of water. The study area is underlain chiefly by crystaline rocks and partly by unaltered sandstones and siltstones. The ground water is derived from local precipitation and generally occurs under water-table condtions. Its movement is restricted by the lack of interconnected openings, and most ground water occurs within 300 feet of the land surface. Hydrographs indicate no long-term change in ground-water storage. A few wells yield more than 100 gallons per minute, but about 70 percent of 286 inventoried wells yield 10 gallons per minute or less; most specific capacities are less than 1.0 gallon per minute per foot. The ground-water quality is generally satisfactory without treatment and there are no known widespread pollution problems. Estimated daily figures on ground-water use are as follows: 780,000 gallons for domestic purposes; 55,000 for commercial purposes; and 160,000 for public supply. Although part of the area is served by an existing surface-water supply and could be served by possible extension of those and other public-supply water mains, much of the rural population is dependent on the ground water available from private wells, tapping the single aquifer that underlies any given location. Neither the ground-water conditions nor this dependence on individual wells is unique to the study area, but, rather, applies to the entire Piedmont province. (USGS)
W82-06686

POROUS MEDIA EQUIVALENTS FOR NETWORKS OF DISCONTINUOUS FRACTURES,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. C. S. Long, J. S. Remer, C. R. Wilson, and P. A. Witherspoon.
Water Resources Research, Vol 18, No 3, p 645-658, June, 1982. 12 Fig, 4 Tab, 36 Ref.

Descriptors: *Porous media, *Model studies, Capillary water, Porosity, Soil porosity, Rocks, Rock properties, *Permeability, *Fracture permeability, Groundwater movement, Hydrology.

The theory of flow through fractured rock and homogeneous anisotropic porous media is used to determine when a fractured rock behaves as a continuum. A fractured rock can be said to behave like an equivalent porous medium when there is an insignificant change in the value of the equivalent permeability with a small addition or subtraction to the test volume and when an equivalent permeability tensor exists which predicts the correct flux when the direction of a constant gradient is changed. Field studies of fracture geometry are reviewed, and a realistic two-dimensional fracture system model is developed. The shape, size, orientation, and location of fractures in an impermeable matrix are random variables in the model. These variables are randomly distributed according to field data currently available in the literature. The fracture system models are subjected to simulated flow tests. The results of the flow tests are plotted as permeability ellipses. The size and shape of these permeability ellipses show that fractured rock does not always behave as a homogeneous, anisotropic porous medium with a symmetric permeability tensor. Fracture systems behave more like porous media when fracture density is increased, apertures are constant rather than distributed, orientations are distributed rather than constant, and larger sample sizes are tested. Preliminary results indicate that the use of this new tool will enhance the ability to analyze field data on fractured rock systems. The tool can be used to distinguish between fractured systems which can be treated as porous media and fractured systems which must be treated as a collection of discrete fracture flow paths. (Baker-FRC)
W82-06851

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. Noorishad, and M. Mehran.
Water Resources Research, Vol 18, No 3, p 588-596, June, 1982. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Solute transport, *Mathematical studies, *Porosity, *Porous media, Capillary water, *Finite element method, Groundwater, Geologic fractures, *Fractured porous media.

The problem of two-dimensional transient transport of solutes in fractured porous media is considered using an upstream finite element scheme. The processes of advection, dispersion, diffusion, adsorption, and first-order reaction in the fracture and porous matrix are included in the mathematical model. The numerical algorithm first solves the fluid flow problem in the region of interest and then by an auxiliary finite element routine the nodal point velocities of the continuum elements are determined. This procedure ensures continuity of velocity across element boundaries, and also it is required for implementation of upstream weighting functions. Fracture element velocities are average velocities calculated directly from endpoint pressures. Knowing the fluid flow field, the code then solves the transport equation using its own nonsymmetric solver. A unique feature of this study is the representation of discrete fractures by two-nodal point elements. This facilitates the mesh generation and numbering of the elements as well as enhancing the computation efficiency and reducing the required computer storage. The validity of the numerical scheme was established through comparison with existing one- and two-dimensional analytic solutions. (Baker-FRC)
W82-06858

IDENTIFICATION OF AQUIFER TRANSMISSIVITIES: THE COMPARISON MODEL METHOD,
Milan Univ. (Italy). Inst. of Geofisica.
G. Ponzini, and A. Lozej.
Water Resources Research, Vol 18, No 3, p 597-622, June, 1982. 27 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Aquifer properties, Hydrogeology, *Groundwater, *Transmissivity, Geology, Hydrology, Piezometric head, Mathematical studies, Water resources development, Groundwater management.

A method is presented for solving the inverse problem in hydrogeology. The method is suitable for computing the interblock transmissivities (harmonic mean or others) referred to the sides of the network blocks of a nonhomogeneous, anisotropic aquifer in steady state flow. The interblock transmissivities computing procedure is based on the comparison between real gradients and those generated by a comparison model whose initial transmissivity value is arbitrarily chosen and constant throughout the surveyed area. Alternative solutions of interblock transmissivities, one for each constant initial transmissivity value utilized in the comparison model, are obtained. In general these solutions differ from each other, but all present characteristics of being able to reproduce the real piezometric heads, respecting the geometry and the boundary conditions of the real aquifer. The selection of the value or set of values of the initial transmissivity to put into the permit selection of a value or a set of values of initial transmissivity. These criteria exploit only the data needed for the solution of the inverse problem and lead to a suitable initial transmissivity which allows one to obtain a good and meaningful solution of computed interblock transmissivities. The comparison model method and the two aforementioned criteria have been applied to a numerical case study, giving good results. (Baker-FRC)
W82-06859

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. Soughty, G. Hellstrom, and C. F. Tsang.
Water Resurces Research, Vol 18, No 3, p 571-587, June, 1982, 19 Fig, 1 Tab, 26 Ref.

Descriptors: *Aquifers, *Thermal water, Storage, Aquifer properties, *Thermal pollution, Heated water, Plumes, Thermal power, Hydrothermal studies, Heat, Model studies.

Thermal behavior around a storage well is considered in the case when buoyancy effects can be neglected. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A numerical model using a steady flow field is used to simulate heat transport in the aquifer and confining layers around the injection/production well during the aquifer thermal energy storage (ATES) cycle. The key parameters are varied to understand their influence on the percent of the injected energy that can be recovered and the temperature of the extracted water. The storage volume appeared as a fundamental parameter of the system. The relative heat loss was roughly proportional to the surface to volume ratio. The thermal behavior of the storage system was very sensitive to the value of the effective thermal conductivity in the aquifer. After an initial transient period, the heat loss through the upper surface of the aquifer was determined by the thickness of the cap rock. The cycle is divided into periods of injection, storage, production and rest in accordance with the supply and demand of heat. The relative duration of these periods appears to have a fairly small influence on the recovery factor when the length of the cycle is constant. The recovery factor when the length of the cycle is constant. The recovery factor increased with the number of storage cycles. During each cycle heat was lost to the cold surroundings. The thermal pollution appears to spread out at a rather slow rate when there is no regional flow in the aquifer. The shape of the heated volume should be as compact as possible to minimize the heat loss. (Baker-FRC)
W82-06861

NUMERICAL TREATMENT OF LEAKY AQUIFERS IN THE SHORT TIME RANGE,
Universidad Nacional Autonoma de Mexico. Mexico City. Centro de Investigaciones en Matematicas Aplicadas y en Sistemas.
B. Chen, and I. Herrera.
Water Resources Research, Vol 18, No 3, p 557-562, June, 1982. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Aquifers, *Leakage, Mathematical equations, Model studies, Mathematical models, *Leaky aquifers, Water loss, Permeability.

A procedure is presented which permits the avoidance, to a large extent, of several difficulties in the numerical treatment of leaky aquifers in the short time range. The method is based on the integrodifferential equations approach. A method that can be applied to control the error is also presented. Leaky aquifers are characterized by the fact that the permeabilities of the semipervious layers sepa-

rating the main aquifers are very small. When the difference in permeabilities between the main aquifers and the aquitards is one order of magnitude or more, the flow can be taken as vertical in the aquitards. Attention is restricted to the case of one main aquifer limited above by one aquitard and overlying an impermeable bed. The analysis is applicable, however, to a multiaquifer system in the short time range because in this range the interaction between the main aquifers is not perceptible. Also, if the main aquifer overlies another aquitard, the modification of the arguments is straightforward. (Baker-FRC)
W82-06863

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
A. D. Gupta, and P. N. D. D. Yapa.
Water Resources Research, Vol 18, No 3, p 546-556, June, 1982, 14 Fig, 18 Ref.

Descriptors: *Aquifers, *Saline water intrusion, Model studies, Encroachment, Saline water, Salinity, Brines, Seawater, *Thailand, Bangkok.

A study was undertaken to provide an insight into the mechanism of saltwater contamination based on the phenomenon of hydrodynamic dispersion. An approach considering both analytical and numerical models for assessing the saltwater encroachment phenomenon in an aquifer was found to be quite efficient in field situations with limited information available on salt concentration and parametric variations. A case study of saltwater encroachment in Bangkok, Thailand was used to illustrate this approach in identifying the sources of contaminating water and in evaluating the effectiveness of the water quality monitoring network. The important point to be noted is the advantage of doing a one-dimensional model analysis and a two-dimensional model analysis simultaneously. By this means computing effort will be minimized, and in addition, a proper assessment for the approximation of the parameters can be made. It was concluded that saltwater encroachment in the Phra Pradaeng aquifer does not occur only from the sea. Connate water bodies entrapped in sediments from the time of deposition under marine coditions are predominant in the contamination of fresh water supplies. These bodies are located to the west and southwest of the Chao Phraya River, where the average initial chloride concentration was about 8000 mg/liter. Either vertical leakage of saltwater from the upper aquifer of brackish water content occurs, or some wells from which wate samples had been collected were improperly grouted. Both conditions may have existed. Attempts will be made in Thailand to simulate salt water movement, along with the simulation of the flow regimes. (Baker-FRC)
W82-06864

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer, and D. K. Maurer.
Open-File Report 80-1123 (WRI), 1981. 29 p, 18 Fig, 12 Ref.

Descriptors: *Groundwater, *Geophysis, *Gravity studies, Aluvial deposits, Bedrock, Resistivity, Playas, Water quality, *Nevada, Washoe County, Lemmon Valley, Silver Lake.

Rapid growth in the Lemmon Valley area, Nevada, during recent years has put increasing importance on knowledge of stored ground water for the valley. Data that would fill voids left by previous studies are depth to bedrock and depth to good-quality water beneath the two playas in the valley. Depths to bedrock calculated from a gravity survey in Lemmon Valley indicate that the western part of Lemmon Valley is considerably deeper than the eastern part. Maximum depth in the western part is about 2,600 feet below land surface. This depression approximately underlies the Silver Lake playa. A smaller, shallower depression with a maximum depth of about 1,500 feet below land surface exists about 2.5 miles north of the playa. The eastern area is considerably shallower. The maximum calculated depth to bedrock is about 1,000 feet below land surface, but the depth throughout most the eastern area is only about 400 feet below land surface. An electrical resistivity survey in Lemmon Valley consisting of 10 Schlumberger soundings was conducted around the playas. The maximum depth of poor-quality water (characterized by a resistivity less than 20 ohm-meters) differed considerably from place to place. Maximum depths of poor-quality water beneath the playa east of Stead varied from about 120 feet to almost 570 feet below land surface. At the Silver Lake playa, the maximum depths varied from about 40 feet in the west to 490 feet in the east. (USGS)
W82-06949

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-06952

2G. Water In Soils

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
A. W. Warrick, D. O. Lomen, and P. J. Tonellato.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243528, Price codes: A05 in paper copy, A01 in microfiche. Report, 1981. 78 p, 2 Fig, 6 Tab, 18 Ref, 4 Append. OWRT B-097-ARIZ(1).

Descriptors: *Soil moisture, *Water pollution sources, *Computer programs, *Trickle irrigation, *Numerical analysis, Groundwater runoff, Linear programming, Mathematical studies, Statistical analysis, Algorithms, Experimental design, Water use, Mathematical models, Algorithms, Plant growth, Ecological effects, Simulation analysis, Soil water.

Theory, computer program subroutines, and applications are described which demonstrate ready application of available solutions descriptive of flow from line and point sources. The linearized forms presented are the only analytical (as opposed to numerical) forms currently available, which are relevant to trickle irrigation geometries. The basic approach has been to document ready-to-use FORTRAN programs which can be used, in whole or in part, to give numerical answers. The programs can be directly used without studying their derivations. Applications are illustrated in eight examples appropriate to trickle irrigation, with the data and output presented. The examples range from a steady-state line source, to a cyclical point source with a cylindrical sink to simulate plant water uptake from the soil. Two of the computer programs presented are set up to solve important two- and three-dimensional problems. For cases not covered by these two programs, subroutines are given as a shortcut to compose algorithms needed to compute the solution. Answers are expressed in tabular and plot formats, giving distributions of matric flux potentials and pressure heads. (Zielinski-MAXIMA)
W82-05928

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
For primary bibliographic entry see Field 7B.
W82-05956

A COMPARISON OF THREE INFILTRATION MODELS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
B. N. Wilson, D. C. Slack, and R. A. Young.
Transactions of the ASAE, Vol 25, No 2, p 349-356, March/April, 1982. 3 Fig, 6 Tab, 30 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Model studies, Green-Ampt-Mein-Larson models, Ponding.

The theoretical development and performance of three infiltration models are compared. The models were an unmodified Green-Ampt-Mein-Larson model (GAML-UNMOD), a similar model modified to account for entrapped air (GAML-ETA), and a model which includes air entrapment and air resistance effects (GAML-ART). The GAML-UNMOD model, conceptually the simplest, did not predict time to surface ponding accurately. The errors were probably a result of unmodified saturated hydraulic conductivity values. The GAML-ETA predicted time to ponding reasonable well but greatly overestimated infiltration on wetter soils. The GAML-ART model produced the best overall results but tended to overestimate on wet soils. This problem with overprediction on wet soils may be a result of partial surface sealing during preceding dry runs. Field data were obtained in Minnesota on four soil types (loam, loamy sand, and two clay loams) using a sprinkling infiltometer. These infiltration models should be used with caution on disturbed watersheds and on soil susceptible to surface sealing. (Cassar-FRC)
W82-05965

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-05969

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,
Arkansas Univ., Fayetteville. Water Resources Research Center.
J. T. Gilmour, J. A. Ferguson, and B. R. Wells.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254962, Price codes: A04 in paper copy, A01 in microfiche. Publication No 82, December 1981. 57 p, 16 Fig, 5 Tab, 4 Ref, 1 Append. OWRT A-045-ARK(1), 14-34-0001-8004.

Descriptors: *Computer models, *Salt balance, *hydrologic budget, *Rice, *Soybean, *Irrigation practices, Model studies, Mathematical models, Mathematical studies, Computer programs, Irrigation water, Irrigation, Physiographic balance, Physiographic provinces, Soil water, Silt, Loam, Soil types.

A computer model was developed for describing salt and water balances for a silt loam soil common to the Arkansas Grand Praire physiographic region. This model was used to assess ten years (1966-75) of weather data for two divergent cases with respect to salt accumulation: one, a rice-soybean rotation, with soybean irrigated; the other, a rice-soybean-soybean rotation, with soybean not irrigated. The salts considered were: calcium, magnesium, sodium, sulfate, chloride, and the precipitate, calcium carbonate. Without soybean irrigation, less evapotranspiration, greater infiltration, and less runoff were observed during the fallow season than when soybeans were irrigated. Other water balance differences were small. Further, annual salt additions were notably larger when soybeans were irrigated and rice occurred more frequently in the rotation. Most salt additions occurred during the rice season for either case stud-

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ied. Accumulation of a given soil salt increased linearly with an increase in irrigation water concentration for that salt, with the rate of increase greatest for sulfate and least for magnesium. The weather data file and the computer program for the model are delineated. (Zielinski-MAXIMA)
W82-06172

SIZE AND SHAPE IN RAISED MIRE ECOSYSTEMS: A GEOPHYSICAL MODEL,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
H. A. P. Ingram.
Nature (London), Vol 297, No 5864, P 300-303, May, 27, 1982. 5 Fig, 1 Tab, 36 Ref.

Descriptors: *Bogs, *Model studies, Waterlogging, Drainage, Wetlands, *Peat bogs, Mathematical studies, Geophysics.

The development of raised mires or raised bogs is marked by the accumulation of peat deposits which, in surface profile, resemble inverted clock glasses. The growth of such a deposit is possible because it remains perennially waterlogged almost to its upper surface. The central parts of the surface may lie at altitudes up to 10 meters above the marginal lagg steams into which the deposit of raised mires is examined. Having identified impeded drainage as the mechanism, implications for the shapes of these ecosystems are then considered. A groundwater mound hypothesis is presented, which appears to have a secure physical foundation and is considered with evidence from various sources. The model used involves impeded drainage and is in good accordance with the structure of the peat and basic tenets of soil physics. At Dun Moss, a small raised mire in east Perthshire, enough hydrological and soil physical data were available to conduct a preliminary test, and the elliptical shape and proportions of the mire surface profile are in agreement with the model used. (Baker-FRC)
W82-06215

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 623-639, May, 1982. 9 Fig, 1 Tab, 30 Ref. OWRT A-076-ARIZ.

Descriptors: *Mathematical studies, *Boreholes, *Permeability coefficient, *Soil water, *Vadose water, Infilitration, Groundwater movement, Hydraulic permeability, Permeability, Mathematical equations, Soil water table, Water table fluctuations, Capillary water.

The accuracy of existing formulas for evaluating the saturated hydraulic conductivity or permeability coefficient in constant head infiltration tests is examined in the first part of a three part study on borehole technology. Formulas are available for open and partly cased boreholes and deep and shallow water table conditions. Not all the available solutions are compatible with each other, and some may lead to values of saturated hydraulic conductivity which differ by as much as several hundred percent from values obtained by other formulas under the same test conditions. None of the solutions account for capillary effects, soil heterogeneity, anisotropy or the possibility that part of the flow may take place under unsaturated conditions. Problems of application of Cecen's methodology to actual field situations are discussed. The United States Bureau of Reclamation formulas may also be inaccurate for an open-hole test above an impermeable layer since, in reality, the flow is not purely horizontal and takes place under nonsteady-state conditions. (Geiger-FRC)
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics, Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 640-659, May, 1982. 16 Fig, 1 Tab, 29 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Soil water, *Infiltration, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Groundwater movement, Water table fluctuations, Mathematical models, Saturation.

The mathematical accuracy of formulas used to determine the saturated conductivity from constant head borehole infiltration tests above the water table was tested under the assumption that the concept of free surface flow is valid. The effects that unsaturated soil conditions may have on the validity of the free surface concept were also studied using free surface and saturated-unsaturated flow models. Free surface model steady state simulations agreed well with analytical solutions but gave a distorted view of the infiltration process. Saturated-unsaturated models used to describe quasi-steady state conditions showed that only a small volume of soil near the borehole is completely saturated with water. An empirical solution was developed for deep table conditions to calculate the saturated hydraulic conductivity with improved accuracy. The development of a completely general formula is extremely difficult due to the effects of borehole geometry, unsaturated soil characteristics, water table depth, heterogeneity, and anisotropy. (Geiger-FRC)
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 660-677, May, 1982. 14 Fig, 2 Tab, 15 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Infiltration, *Soil water, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Water table fluctuations, Mathematical models, Graphical methods, Saturation, Soil properties, Groundwater movement, Flow rates, Permeability.

During constant head borehole infiltration tests in the vadose zone, saturated-unsaturated flow models were used to simulate transient conditions. The time required to reach steady state, the volume of injected water required to reach steady state, and the question of whether early time data from a borehole infiltration test could be used to estimate saturated hydraulic conductivity were also examined. Infiltration rate varied directly with saturated hydraulic conductivity and was affected by unsaturated soil properties, antecedent moisture conditions, anisotropy and borehole conditions. Saturated hydraulic conductivity may be overestimated if the U.S. Bureau of Reclamation method of determining when to terminate a test is used. By using a graphical method which utilizes extrapolation of data collected during the early portion of a test, lengthy tests and the need for large volumes of water are eliminated when estimating flow rate at steady state. (Geiger-FRC)
W82-06303

SIMULATION OF SOLUTE TRANSPORT USING A TRANSFER FUNCTION MODEL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury.
Water Resources Research, Vol 18, No 2, p 363-368, April, 1982. 4 Fig, 20 Ref.

Descriptors: *Simulation analysis, *Mathematical studies, *Soil water, Water transport, *Mathematical models, Flow, Soil solution, *Solutes, Spatial distribution, Probability distribution, Infiltration, Prediction, Velocity, Soil environment.

A transfer function model is proposed for simulating solute transport under natural field conditions where substantial variability exists in water transport properties. A transfer function model is a device commonly used by electrical engineers and hydrologists to characterize systems whose internal mechanisms are unknown or unknowable. This approach measures the distribution of solute travel times from the soil surface to a reference depth. Using the distribution function, it is possible to simulate average solute concentration for a given depth or time, and to predict the probability of extremely long or short travel times for a mobile chemical. Since in the few existing studies of soil water distributions, it was found that a lognormal function describes the relevant parmeter, that is the distribution to which the travel time density function is fitted in this study. (Titus-FRC)
W82-06318

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W82-06321

ESTIMATING SOIL WATER RETENTION FROM SOIL PROPERTIES,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and D. L. Brakensiek.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 166-171, June, 1982. 1 Tab, 18 Ref.

Descriptors: *Soil moisture retention, *Soil properties, Soil types, Soil water, *Matric potential.

Three levels of regression equations for predicting soil water retention at 12 matric potentials (-0.04 to -15 bar) were developed based on: (1) percent sand silt, and clay, percent organic mater, and bulk density; (2) number 1 variables plus -15 bar soil water retention value; and (3) number 2 variables plus -0.33 bar soil water retention value. Data for this study included 500 soils consisting of 2543 soil horizons from 18 states and covered a wide variety of soil types. Addition of the -0.44 bar and -15 bar soil retention values greatly increased the accuracy of the equations. These equations can be used to estimate water retention characteristics without expensive laboratory determinations. (Cassar-FRC)
W82-06332

A FIELD TEST OF THE TRANSFER FUNCTION MODEL FOR PREDICTING SOLUTE TRANSPORT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, and P. Shouse.
Water Resources Research, Vol 18, No 2, p 369-375, April, 1982. 1 Tab, 8 Fig, 13 Ref.

Descriptors: *Mathematical models, *Solutes, Field investigation, *Probability distribution, Water transport, Chloride, Irrigation, Soil water, Soil solution, Saturation, Statistical analysis, Leaching, Calibrations.

A model proposed for predicting average values of solute concentration as a function of depth and time, based on a transfer function model, is tested on a field experiment. The model, which requires knowledge of the distribution of solute travel times to a given depth within a field, predicts average soil solute concentrations and the probability of extreme behavior. The experiment consisted of an initial calibration of a pulse of solute past numerous samplers at a constant depth. The shape of the solute pulse was then predicted for different depths, with good agreement between predicted and measured values. A further test of the model involved taking soil cores after 170 days. Good agreement was found in this test as well. The experiment suggests that the number of replicate samples required depends on the degree to which extreme values are important. (Titus-FRC)
W82-06339

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT EQUATION,
Science and Education Administration, Riverside, CA. Salinity Lab.
M. T. van Genuchten, and W. J. Alves.
Technical Bulletin No 1661, June 1982. 151 p, 5 Fig, 1 Tab, 45 Ref, 2 Append.

Descriptors: *Solute transport, *Mathematical models, *Computer models, *Soil water, Convection, Adsorption, Laplace equation.

The rate at which a chemical constituent moves through soil is determined by several transport mechanisms. This compendium lists available mathematical models and associated computer programs for solution of the one-dimensional convective-dispersive solute transport equation. The governing transport equations include terms accounting for convection, diffusion and dispersion and linear equilibrium adsorption. In some cases, the effects of zero-order production and first-order decay have also been taken into account. Some of the listed solutions have been published previously. Others were not available and have been derived to make the list of solutions more complete. User-oriented FORTRAN IV computer programs of several analytical solutions are given in an appendix. All programs were successfully tested on an IBM 370/155 computer. Results of each program were compared with results based on a numerical solution of the governing transport equation, in order to check the programming accuracy of each solution. A list of Laplace transforms used to derive the analytical solutions is also provided. (Moore-SRC)
W82-06408

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,
Agriculture Research Service, Riverside, CA. Salinity Lab.
M. T. Van Genuchten.
Advances in Water Resources, Vol 5, No 1 p 47-55, March, 1982. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Solute transport, *Numerical analysis, *Soil water, *Finite element method, *Finite difference methods, Unsaturated flow, Saturated flow, Fate of pollutants, Model studies, Infiltration, Mathematical models, Hydrodynamics.

The accuracy and computational efficiency of four numerical methods for solving governing one-dimensional flow and mass transport equations are compared. The methods are those of finite differences (FD), linear finite elements (LFE), mass-lumped linear finite elements (MFE), and Hermitian cubic finite elements (HFE). These equations are useful for studying movement of fertilizers, pesticides, salts, and domestic and industrial wastes in the soil. The sample problem is a field infiltration experiment in which water and chlorides infiltrate into a deep, homogeneous soil profile. All four numerical schemes give accurate results, but the HFE scheme most nearly duplicates the correct solution. Computer times vary widely, depending on the number and size of elements, number of time steps, etc. The GFD and MFE schemes generate the most stable conditions in the presence of a steep moisture front (infiltration in a dry soil); the HFE scheme is better for locating the correct spatial position of the moisture front. Selection of a numerical scheme should consider its potential use. Factors affecting accuracy and computational efficiency are programming details of the iterative scheme, magnitude of the time step, the presence of adsorption and decay reactions, and the required accuracy. (Cassar-FRC)
W82-06547

AN EMPIRICAL METHOD FOR DETERMINING AVERAGE SOIL INFILTRATION RATES AND RUNOFF, POWDER RIVER STRUCTURAL BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
J. G. Rankl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201732, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-76, April 1982, 38 p, 18 Fig, 10 Ref.

Descriptors: *Soil water, *Infiltration rate, *Surface runoff, *Rainfall-runoff relationships, Rainfall intensity, Antecedent moisture, Channel storage, Water storage, Permeability, Soil types, Soil classification, *Wyoming, Powder River basin, Incipient ponding.

This report describes a method to estimate infiltration rates of soils for use in estimating runoff from small basins. Average rainfall intensity is plotted against storm duration on log-log paper. All rainfall events are designated as having either runoff or nonrunoff. A power-decay-type curve is visually fitted to separate the two types of rainfall events. This separation curve is an incipient-ponding curve and its equation describes infiltration parameters for a soil. For basins with more than one soil complex, only the incipient-ponding curve for the soil complex with the lowest infiltration rate can be defined using the separation technique. Incipient-ponding curves for soils with infiltration rates greater than the lowest curve are defined by ranking the soils according to their relative permeabilities and optimizing the curve position. A comparison of results for six basins produced computed total runoff for all events used ranging from 16.6 percent less to 2.3 percent more than measured total runoff. (USGS)
W82-06692

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
For primary bibliographic entry see Field 3F.
W82-06852

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,
Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
D. Russo, and E. Bresler.
Water Resources Research, Vol 18, No 3, p 438-488, June, 1982. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Unsaturated flow, *Stochastic process, Mathematical studies, Probabilistic process, Stochastic hydrology, Soil water, Infiltration, Salts.

Comparisons were made between solutions of stochastic-conceptual flow problems obtained by using two approaches: assuming that the spatial variability of soil hydraulic properties is expressed by a single stochastic parameter or assuming that this variability is described by five random parameters. Two cases of one-dimensional vertical flow were analyzed: piston flow of solute under steady uniform surface water recharge and transient water flow when a uniform recharge rate is applied on the surface. Under steady vertical infiltration, expressing the variability of the hydraulic conductivity function by the single stochastic variate gives essentially the same results as the case when the variability is expressed by three stochastic variates. The agreement between the simulated average solute concentration profiles obtained by the two methods improved as the recharge rate increased and a larger portion of the field was under ponding conditions. Similar results were found for the simulated potential runoff. For the case of the transient flow of water the variability in the hydraulic conductivity function as well as the variability in the soil water retentivity function is expressed by a scaling factor obtained from hydraulic conductivity data. Using this scaling factor as the only stochastic variate resulted in mean water content profiles which are in relatively good agreement with the mean profiles obtained when expressing the variability of the hydraulic conductivity function and the soil water retentivity function by five stochastic variates. It is concluded that the scaling factor, as a single stochastic variate, can be successfully used for stochastic analysis of water and solute flows under steady and transient infiltration conditions. (Baker-FRC)
W82-06856

MOISTURE AND HEAT TRANSPORT IN HYSTERETIC, INHOMOGENEOUS POROUS MEDIA: A MATRIC HEAD-BASED FORMULATION AND A NUMERICAL MODEL,
Massachusetts Inst. of Tech. Cambridge. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol 18, No 3, p 489-498, June, 1982. 8 Fig, 35 Ref.

Descriptors: *Soil porosity, *Model studies, *Porosity, Soil properties, *Porous media, Evapotranspiration, Groundwater recharge, Runoff, Precipitation, Rainfall, Model studies, Mathematical models.

The theory of Philip and de Vries and of de Vries is used as the basis for the formulation of a more general mathematical model of moisture and heat flow in porous media. Specifically, matric head rather than moisture content is used as a dependent variable. This makes it possible to incorporate moisture retention hysteresis and soil inhomogeneities into the theory. A physically realistic generalization of existing conceptual models of hysteresis is proposed in order that they may be applied to non-isothermal problems. The one-dimensional forms of the governing partial differential equations are solved numerically using the Galerkin finite element method. A computer code of the proposed solution algorithm is tested for accuracy in the solution of several problems. The limitation of the assumptions of local thermodynamic equilibrium are discusse e computational results demonstrate the reliability of the numerical model. (Baker-FRC)
W82-06857

COMPARISON OF METHODS OT ESTIMATE DEEP PERCOLATION RATES,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis, D. D. Evans, and A. W. Warrick.
Water Resources Bulletin, Vol 18, No 3, p 465-470, June, 1982, 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Percolation, Estimating, *Darcy's equation, Temperature effects, *Evapotranspiration, Irrigation, Soil moisture, *Root zone, Tracers, Tritium.

Three alternative methods of estimating deep percolation below the root zone when knowledge about the history of applied water and evapotranspiration is not available are evaluated. The methods studied included: the solutions of Darcy's equation for steady state conditions; the estimation of deep percolation rates based upon the distortion caused by the vertical flux of water and of the normal vertical temperature profile in the zone below 15 meters; and the use of tritium as a tracer of water movement. A field site for determining the deep seepage rate by all three methods was selected in a field west of Phoenix, Arizona. The water table was at a depth of 42 meters and the field had been under irrigation since 1950. Cropping history included field crops for the previous 18 years and vegetable crops before that time. At the principal study site the Darcy velocity of flow ranged from 9 cm per year determined by the temperature method to 40 cm per year determined by the tritium method. Darcy's equation to calculate seepage rates resulted in an estimation of deep seepage of 18 cm per year. An average deep percolation rate at the principal study site of 22 cm per year was determined using the average of all three methods. Results for other sites based on the temperature method indicated a lower seepage rate. If the three methods, the hydraulic approach offered the most direct measurement of seepage rate. However, it is also the most laborious and expensive. (Baker-FRC)
W82-06867

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SEASONAL VARIATION OF INFILTRATION CAPACITIES OF SOILS IN WESTERN OREGON,
Coconino National Forest, Flagstaff, AZ.
M. G. Johnson, and R. L. Beschta.
Pacific Northwest Forest and Range Experiment Station Research Note PNW-373, 1981. 8 p, 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Infiltration capacity, *Forest soils, *Seasonal variation, *Soil organic matter, *Oregon, Wettability, Water repellent soils, Coniferous forests, Climates.

Infiltration measurements were made at two locations in Oregon: the Coyote Creek watersheds, located in the South Umpqua Experimental Forest; and the Hi-15 watersheds, located in the H. J. Andrews Experimental Forest. Both areas have relatively dry, warm summers and wet, mild winters. Douglas-Fir dominates the overstory vegetation of undisturbed sites at both areas. Infiltration capacities for the Coyote Creek and Hi-15 watersheds averaged about 50% higher in the fall than during the summer. All data on infiltration capacity appear to be normally distributed. The pattern of greater infiltration in fall, compared with summer, was found in both disturbed and undisturbed soils at both study areas. The cause of this seasonal increase in infiltration capacity is not known. Field observations indicate that during the summer months the soil surface presents a nonwettable condition. This condition may result from changes in characteristics of the soil organic matter caused by the hot and dry climate of summer. This surface-limiting condition apparently changes after the first fall rains. In contrast to the results of this study, most other investigators have found fall infiltration capacities 30-80% lower han those occurring during summer. (Moore-SRC)
W82-06961

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W82-06969

2H. Lakes

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-05912

GRAPHIC RETRIEVAL, ANALYSIS AND SPATIAL PORTRAYAL: AN INFORMATION SYSTEM FOR IDAHO'S FRESHWATER LAKES,
Idaho Univ., Moscow. Dept. of Geography.
N. B. Hultquist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243387, Price codes: A05 in paper copy, A01 in microfiche. Report, January 1982, 82 p, 7 Fig, 1 Append. OWRT A-073-IDA(1).

Descriptors: *Mapping, *Lakes, *Data storage and retrieval, *Data processing, *Computer programs, Topographic mapping, Lake classification, Data collections, Data interpretations, Computer models, Model studies, Model testing, Mathematical models, Mathematical studies, Mathematical analysis.

Activities on a data processing project related to the Clean Lakes study, designated as GRASP (Graphic Retrieval and Spacial Portrayal), are described. The rationale, description, and application of GRASP are delineated. The objective of GRASP is to develop a computer based storage and retrieval system having analysis capacilities to facilitate graphic and or spatial portrayal of raw data or of derived information needed by Clean Lakes researchers. An exhaustive search was made by the researchers to identify all Idaho lakes. The final form of this search includes lakes, reservoirs, and ponds. Each water body is uniquely identified by name, location, elevation, and size. A total of 123 high priority lakes are tagged in the system and given a water quality status (trophic status index). The information within the GRASP system can be displayed, corrected, or expanded using the editing function of the Conversational Monitoring System. Sorting, logical operations, and analyses are possible, using interactive statistical analysis system routines. Simple maps (and other graphics) are optional products available to the researchers, and lakes of interest can be spatially portrayed at the appropriate level within Idaho State/county outlines. (Zielinski-Maxima)
W82-05914

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,
World Health Organization Schistosomiasis Control Project, Accra (Ghana).
For primary bibliographic entry see Field 5C.
W82-05988

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5B.
W82-05991

FACTORS INFLUENCING ORTHOPHOSPATE TURNOVER TIMES: A COMPARISION OF CANADIAN AND NEW ZEALAND LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
E. White, G. Payne, S. Pickmere, and F. R. Pick,.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 469-474, March 1982. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Phosphates, *Turnover time, *Nutrients, Lakes, *Canada, *New Zealand, Limiting nutrients, Phosphorus, Nitrogen, Phytoplankton, Particulat matter, Seston, *Orthophosphates.

Water samples from 21 New Zealand and 9 Canadian lakes were analyzed for dissolved phosphate, particulate phosphorus, and particulate nitrogen. The particulate N was used to indicate phytoplankton biomass; the ratio of particulate N to particulate P was used to indicate P sufficiency or deficiency. Phosphate turnover times were positively related to the size of the dissolved phosphate pool, negatively related to biomass. Where P deficiency existed, phosphate turnover times were short. Particulate N/particulate P ratios for Canadian and New Zeland lake water averaged 26.96 and 12.71, respectively. In the 3 New Zeland lake groups the average particulate N/P ratios ranged from 8.61 to 16.06. The lower ratios were found in New Zealand lakes located in P-rich regions of volcanic ash and fed by P-rich springs. (Cassar-FRC)
W82-05992

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,
Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-05993

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,
New York State Department of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5C.
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,
Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-05996

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06034

ANALYSIS OF LAKE VICTORIA LEVELS,
G. W. Kite.
Hydrological Sciences Bulletin, Vol 27, No 2, p 99-110, June, 1982. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Lakes, *Water level, *Lake Victora, Model studies, Mathematical studies, Hydrologic models, Mathematical models, Water level fluctuations.

An analysis was made of time series of levels of Lake Victoria as measured at four points for trends, periodicities and autoregressive components. Comparisons were made with results of time series analysis of Lake Superior, which is similarly sized lake. Checks were made for evidence of differential crustal movement using differences between time series on opposiste sides of the lake. The time series of beginning of month lake levels for the period 1900-1978 contains trends, contains periodicities and contains a strong autoregressive component. The trend component of the time series is generally associaaed with changes in the structure of the series caused by natural or manmade phenomena. The presence of periodic functions is generally attributed to various astromnomical events such as the phases of the moon and the rotation of the earth. All of the Lake Victoria time series show a similar distribution of variance and are in marked conrast to the distribuion of variance for the lake level time series from Marquette on LakeSuperior. The Lake Victoria series contain large (greater than 50%) linear trends, while the Marquette series contains a large periodic component. All series contain a large autoregressive component. The linear trand components in the Lake Victoria series are largely caused by the step inlake levels in the early 1960's. Since it appears that this rise in lake level is not manmade, the time series cannot be legitimately homogenized by removing the steps, and any method of analysis which is to be of use in modeling must incorporate a random jump component. (Baker-FRC)
W82-06201

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,
Rhode Island Univ., Kingston. Dept. of Chemistry.
For primary bibliographic entry see Field 2D.
W82-06216

HEAVY METALS IN ANIMALS OF LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 5C.
W82-06284

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5B.
W82-06285

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,
Arhus Amtsvandvaesen (Denmark).
For primary bibliographic entry see Field 5C.
W82-06313

HYPOLIMNETIC REDOX AND PHOSPHORUS CYCLING IN HYPEREUTROPHIC LAKE SEBASTICOOK, MAINE,
Maine Univ. at Orono. Dept. of Geological Sciences.
L. M. Mayer, F. P. Liotta, and S. A. Norton.
Water Research, Vol 16, No 7, p 1189-1196, July, 1982. 10 fig, 2 Tab, 42 Ref. OWRT A-039-ME.

Descriptors: *Nutrients, *Lakes, Eutrophication, *Cycling nutrients, *Phosphorus, Alkalinity, Oxygen demand, Hypolimnion, Thermal stratification, Ammonium, Methane, Iron, Manganese, Sulfides, Sediments, *Maine, Lake Sebasticook.

The types of reduced species delivered to the metalimnion of a hypereutrophic lake are examined. The dynamics of hypolimnetic water chemistry were considered through the summer stratification period with emphasis on the factors controlling the introduction of reduced species to the water column, internal cycling of these species and their effect on phosphate delivery to the epilimnion. Lake Sebasticook is a hypereutrophic lake used for the investigation. The establishment of winter and summer anoxic hypolimnia in Lake Sebasticook followed a pattern typical of a eutrophic dimictic lake. Summer fluctuations of the oxycline represented intrusions of hypoxia into the metalimnion and lower epilimnion rather than massive reoxygenation of the hypolimnion. The response of iron and manganese to this anoxic period was release of both metals from the sediments immediately after the onset of hypolimnetic anoxia, increased in concentration in the hypolimnion throughout the summer, manganese developing an upper hypolimnetic maximum in the late summer-early fall and iron retaining a lower hypolimnetic maximum indicative of release from the sediments. Total phosphorus showed a pattern similar to the metals, building up intensively in the hypolimnion and to a much lesser extent in the epilimnion. Potassium was also apparently released from the sediments during the summer, perhaps resulting from an ion exchange reaction in which potassium was displaced by ammonium derived from deamination of organic material. Considerable alkalinity was also released from the sediments. (Baker-FRC)
W82-06337

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7C.
W82-06370

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 5C.
W82-06383

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,
Australian Water Resources Council, Canberra.
For primary bibliographic entry see Field 5G.
W82-06385

STUDIES OF THE EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, and J. J. Sartoris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237074, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-82-7, December 1981. 59 p, 41 Fig, 9 Tab, 48 Ref.

Descriptors: *Limnology, *Plankton, *Nutrients, *Productivity, *Twin Lakes, *Pumped storage, Reservoirs, Chlorophyll, Phosphorus, Nitrates, Benthos, Water temperature, Conductivity, Dissolved oxygen, *Colorado, Twin Lakes.

This report presents the results of studies done in 1980 as part of the preoperational investigations of the limnology of Twin Lakes. Maximum water temperatures were recorded in August 1980 and were about 17 and 18 C for the upper and lower lakes, respectively. The lowest measured dissolved oxygen concentration was 1.3 mg/l at the bottom of the lower lake in October. The pH ranged between 6.3 and 8.3, and the conductivity levels were between 64 and 90 micro S/cm. Total phosphorus concentrations never exceeded 2 micro g/l during 1980, while nitrate nitrogen ranged from less than 10 to 90 micro g/l. Average daily primary productivity rates ranged from a low of 1.6 mg C/ (sq m/d) in the upper lake during January to a high of 143.5 in the lower lake during November. Chlorophyll a concentrations ranged from 0.6 mg/cu m below 14 m in the lower lake during April to 18.0 mg/cu m near the bottom of the epilimnion in the upper lake during September. Average phytoplankton and zooplankton densities reached maximum of just over 13,000 and 125.8/L, respectively, during August in the lower lake. Phytoplankton populations were dominated by diatoms and dinoflagellates, while zooplankton populations were dominated by copepods, oppossum shrimp, and rotifers. The benthos of Twin Lakes is dominated by chironomids, oligochaetes, and fingernail clams reaching maximum densities respectively of 2922, 800, and 974/sq m in the lower lake, and 1969, 2813, and 173/sq m in the upper lake. (Moore-SRC)
W82-06403

HYDROTHERMAL ANALYSIS OF LAKES AND RESERVOIRS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. R. F. Harleman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 301-325, March, 1982. 16 Fig, 40 Ref.

Descriptors: *Hydrothermal studies, *Mathematical studies, Fluid mechanics, Lakes, Reservoirs, Physical properties, Thermal properties, Prediction.

This paper, of 'First Hunter Rouse Hydraulic Engineering Lecture', reviews the impact of Hunter Rouse's work on the application of fluid mechanics to hydraulic engineering practice in the United States. The development of physical and mathematical techniques for the prediction of the hydrothermal structure of lakes and reservoirs provides an example of the application of concepts put forth by Rouse. One-dimensional models for the vertical temperature structure of lakes and reservoirs may be either diffusion models or mixed-layer models. The development and testing of early mathematical models based on the vertical diffusion concept depended heavily on the use of laboratory models. These models are very sensitive to variations in turbulent diffusivity, internal heat absorption, and vertical advection due to inflows and outflows. A wind-mixing model is proposed as an alternative to specification of temporal and spatial variations in the vertical diffusivity. A wind-mixing algorithm converts turbulent kinetic energy input by wind shear to potential energy through entrainment of hypolimnetic water across the thermocline. A heat balance based on meteorological inputs averaged over hourly or daily time steps is achieved through the use of an interactive technique. This ability to predict the thermal structure of lakes and reservoirs a short time intervals permits the inclusion of this factor in water quality models. Temperature predictions of the numerical model are compared with field data for several lakes and reservoirs. (Carroll-FRC)
W82-06425

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W82-06470

ZOOPLANKTON AND THEIR RELATIONSHIPS WITH WATER QUALITY AND FISHERIES,
Leicester Univ. (England). Dept. of Adult Education.
D. M. Harper, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 135-145, March, 1982. 10 Fig, 23 Ref.

Descriptors: *Zooplankton, *Plankton, *Reservoirs, Water supply, *Water quality data, Fish, *Reservoir operation, Succession, Water treatment, Water sampling, Water quality, Seasonal variation, Rutland Water, England.

Zooplankton population structure in Rutland Water changed over the first five years of the reservoir's existence. Daphnia pulex, initially dominant, was replaced by D. hyalina in late 1975, and since 1979 the latter has coexisted with Bosmina longirostris. Population fluctations of all the main crustacean zooplankters were erratic in the first three years, but have since become more regular. The pattern of zooplankton population change is now similar to that of other lowland reservoirs. The seasonal changes in the populations of the main grazers are becoming predictable, but the effect of grazing upon the algae and their succession during the summer is not yet clear. It is anticipated that a clearer understanding of grazing pressure will be of value to the future management of the reservoir. (Titus-FRC)
W82-06472

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,
Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
A. J. D. Ferguson, and D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 117-133, March, 1982. 2 Tab, 11 Fig, 34 Ref.

Descriptors: *Phytoplankton, *Pumping, *Succession, *Reservoirs, Water supply, England, Catchment areas, Water quality control, Water quality, Prediction, Lakes, Algal blooms, Filtration, Water quality data, Rutland Water.

The development of a seasonal succession of phytoplankton species in Rutland Water is described, and the factors controlling their succession and abundance are discussed. At present, input of water from the catchment and by pumping from the rivers flowing into the reservoir has the greatest influence on phytoplankton abundance. Temperature, fluorescence and oxygen percentage saturation were continuously monitored, as were meteorological factors. Chemical and algal sampling was carried out at weekly intervals at each of thirteen sites. Results of the monitoring showed that increasing stabilization of phytoplankton successional dominance occurred. Currently, the predictive capabilities that result from the study rely on observed changes in growth patterns and experience gained from past data on species succession. The factor considered most readily manipulable in the control of algal populations is the degree of stratification. Examination of the relationships between the mixed depth algal concentrations and species succession have not produced any predictable relations to date. (Titus-FRC)
W82-06473

VERTICAL MOVEMENTS OF THE SURFACE WATER AND THERMAL STRATIFICATION IN RUTLAND WATER,
University Coll. of Swansea (Wales). Dept. of Oceanography.
S. L. Maddocks.

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Hydrobiologia, Vol 88, No 1-2, p 79-87, March, 1982. 5 Tab, 5 Fig, 6 Ref.

Descriptors: *Thermal stratification, *Stratification, *Thermocline, *Reservoirs, *Seiches, Thermal capacity, Wind-driven currents, Currents, Oscillatory waves, Dams, Upwelling, Eutrophication, Topography, Water treatment, Stress, Rutland Water, England.

Vertical movements of the water surface in Rutland Water were examined using water level gauges. The timing and extent of the surface seiches and slopes due to wind stress were not well correlated with wind speed and direction: this is thought to be due to the complex shape of the reservoir. Where the lake consists of many bays and dendritic parts, the oxygen concentration is very different, and each unit often operates as essentially an individual lake. Therefore, the structure of oxygen distribution becomes highly variable horizontally, vertically, and temporally. Unexplainable diel oscillations of the water surface were observed, and an examination of the thermal stratification showed the presence of upwelling and downwelling. The ability to predict seiching is important to engineers for upkeep and dam construction, since seiching (oscillations) helps keep inlets in the reservoir clear of sediment buildup, while producing extra stress on the dam. (Titus-FRC)
W82-06476

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESUSPENSION IN THE EASTERN BASIN OF LAKE ERIE,
Eidenossische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewasserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 2J.
W82-06494

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06496

METHANOGENESIS IN BIG SODA LAKE, NEVADA: AN ALKALINE, MODERATELY HYPERSALINE DESERT LAKE,
Geological Survey, Menlo Park, CA.
R. S. Oremland, L. Marsh, and D. J. DesMarais.
Applied and Environmental Microbiology, Vol 43, No 2, p 462-468, February, 1968. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Methanogenesis, *Methane, *Saline lakes, Methanol, Lake sediments, Biochemistry, Chemical reactions, Salinity, Microbiological studies, Methane bacteria, Lakes, Big Soda Lake, *Nevada.

Although methanogenesis has been studied in a wide variety of aquatic environments, there have been few reports on methanogenesis in hypersaline environments in spite of the apparent phylogenetic link between methanogens and extreme halophiles. This paper reports on methanogenic activity in the sediments of Big Soda Lake, a moderately hypersaline, alkaline desert lake in Nevada. Incubated sediment slurries from the lake produced significant levels of methane. Methane production by the sediment slurries had a pH optimum of 9.7 and was stimulated by methanol, trimethylamine, and methionine. Methanogenesis was inhibited by 2-bromoethanesulfonic acid and by autoclaving. Hydrogen, acetate, and formate amendments were found to provide only slight or no stimulation of methanogenesis in these slurries. A methanol-grown enrichment culture containing a small epifluorescent coccus as the predominant organism was recovered from sediments. This enrichment grew best when ferric sulfide (FeS) or autoclaved sediment particles were included in the media, had a pH optimum of 9.7, and produced 14CH4 from 14CH30H. The methane formed by methanol-grown enrichment cultures was depleted in 13C by 72% to 77% relative to the methanol. (Carroll-FRC)
W82-06535

TERMINOLOGICAL CONFUSION--LAKE VS. RESERVOIR,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 203-205, 1982.

Descriptors: *Lakes, *Reservoirs, *Lake classification, *Nomenclature, Definitions, Arid Climates, Water level fluctuations, Climates, Silting, Sedimentation, Reservoir releases.

The difference between the terms 'lake' and 'reservoir', which are often used interchangeably, is clarified. Lakes are natural water bodies, and reservoirs are manmade. Lakes are formed from natural processes such as faulting, volcanism, glaciation, and others, whereas reservoirs are formed by interfering with natural processes. Lakes are abundant in humid regions, but reservoirs may be built anywhere, even in arid or semi arid places as long as imported water is available. Lakes occupy closed depressions; reservoirs are open at one end and man-enclosed at the other. Most lakes are older than modern civilization, but reservoirs are relatively recent. Lakes have a longer life span than reservoirs, which are readily filled with sediments. Lakes are in harmony with the natural environment; reservoirs alter the biological communities, sometimes favorably and sometimes unfavorably. In lakes water exchange, circulation, and water levels are rather uniform. Reservoirs often have rapid releases and water level fluctuations up to 70 m (Shasta Reservoir). Lakes become more eutrophic with time while reservoirs are flushed more frequently, delaying eutrophication. Although lakes were very important economically in ancient times, the economic impact of reservoirs is now much greater. (Cassar-FRC)
W82-06551

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06570

CALCULATION OF CURRENTS IN LAKE ONEGA WITH CONSIDERATION OF ANTHROPOGENIC INFLUENCES,
Z. N. Dobrovol'skaya, P. P. Koryavof, and A. I. Simonov.
Water Resources, Vol 8, No 3, p 278-281, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 100-104, May/June, 1981.

Descriptors: *Water currents, *Wind-driven currents, *Diversion, Lakes, Water circulation, Lake Onega, Water transfer, Model studies, Numerical analysis, Mathematical models, River flows, Svri' River, Vytegra River, Runoff, Hydraulics, *USSR, Hydrodynamics.

The dynamics of currents in lakes were described by a two-dimensional hydrodynamic model in which the wind effect, river outflow, bottom friction, and Coriolis forces were considered. The particular problem considered was that of determining the zone of Lake Onega in which changes in the current were localized as a result of water being diverted from the Svir' River to the Vytegra River. The numerical method observed that the boundary of the zone of influence of redistribution of the runoff (established on the basis of a 10% difference in current speeds) varied depending on wind direction and volume of redistributed water. The variations were localized in the southern part of the lake at a distance of less than 19 km from the southern boundary for all wind conditions investigated, except a complete calm. (Cassar-FRC)
W82-06612

NUMERICAL MODELING OF WIND-DRIVEN CURRENTS IN LAKE CHUDSKOE,
Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
G. V. Volkova, V. I. Kvon, and T. N. Filatova.
Water Resources, Vol 8, No 3, p 271-278, May/June, 1981. 3 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 3, p 91-99, May/June, 1981.

Descriptors: *Water currents, *Water circulation, Wind-driven currents, Bottom currents, Lake Chudskoe, *USSR, Model studies, Mathematical models, Lake circulation, Numerical analysis, Hydraulics, Hydrodynamics.

A mathematical model for calculating wind-driven currents in seas and inland water bodies was evaluated by comparing model results with 1971-77 field data from Lake Chudskoe, 2670 sq km in area and 7.8 m deep. Calculations of the wind-driven currents showed that currents in the surface layer coincided with wind direction and agreed within 1-3% of observed values. In the bottom layer two circulations developed in the presence of WNW winds: northern anticyclonic and southern cyclonic, the centers of which were in shallow places. Model results of the bottom layer corresponded well with field data. For WNW winds maxiumum current speeds (15-19 cm per sec) were seen in cyclonic circulation; for WSW winds (10-14 cm per sec) in the anticyclonic circulation. The model predicted slightly lower current speeds than were observed. There was also some discrepancy in the region covered by the anticyclonic circulation in case of WSW winds. (Cassar-FRC)
W82-06615

USING DIFFERENCES AMONG CARLSON'S TROPHIC STATE INDEX VALUES IN REGIONAL WATER QUALITY ASSESSMENT,
Metropolitan Council, St. Paul, MN.
R. A. Osgood.
Water Resources Bulletin, Vol 18, No 1, p 67-74, February, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Trophic level, *Water quality, Regional analysis, Data interpretation, Lakes, Lake classification, Chlorophyll, Phosphorus, Secchi disks.

The principal advantage of Carlson's trophic state index used in water quality assessments is that it presents the trophic condition on a 1 to 100 scale easily understood by both the public and the scientific community. However, the ability of the index to communicate trophic information is lessened when three values are reported: trophic state index calculated from total phosphorus, from chlorophyll a, and from Secchi disk transparency. There is at present no systematic way to account for differences among the three index values. Large differences in the three index values may result from either or both of two sources: regional relationships between chlorophyll and either Secchi depth or phosphorus may be different than those used to originally derive the index, and/or a modifying process may be altering the relationship on one of the trophic state index values with respect to the others. Two methods which can be used to account for differing trophic state index values on a regional basis are proposed. The first provides a simple procedure for transforming the trophic state index information to make it consistent with regional relationships between chlorophyll and either Secchi depth or phosphorus. The second uses the three index values to identify modifying processes in a lake and may indicate which value, or combination of values, best reflects the lake's trophic condition. Limnetic data from 60 lakes in the Twin Cities (Minnesota) metropolitan area are used to demonstrate these techniques. Only minor modifications should be needed to apply the procedures to other regional situations. (Carrol-FRC)
W82-06625

SECCHI DISC RELATIONSHIPS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, J. J. Cooper, and S. Vigg.

Water Resources Bulletin, Vol 18, No 1, p 121-123, February, 1982. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Secchi disks, *Reservoirs, *Mathematical equations, Trophic level, Lake classification, Turbidity, Water quality, Transparency, Artificial lakes, Optical properties, Eutrophication.

The problem of estimating bulk light extinction coefficients in surface water impoundments is addressed. Since artificial impoundments tend to be more turbid than natural impoundments, their optical properties, and therefore the Secchi disk depth, tend also to differ from natural impoundments. An accurate method for estimating the bulk extinction coefficient from the Secchi disk depth is demonstrated. The derived equation differs signigicantly from that derived by Poole and Atkins in 1929. The empirical expression developed for the extinction coefficient is then used to derive a semi-empirical expression for the eutrophic depth as a function of the Secchi disk depth. The relationships derived provide reasonably accurate fits of the data collected by several investigators under diverse conditions in a number of artificial impoundments. It is recommended that the results of this effort be applied only in artificial impoundments. (Carroll-FRC)
W82-06627

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. M. Jacoby, D. D. Lynch, E. B. Welch, and M. A. Perkins.
Water Research, Vol 16, No 6, p 911-919, June, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Lakes, *Phosphorus, Eutrophication, Sediments, *Lake sediments, Lake restoration, Cycling nutrients, Macrophytes, Decomposition, Decomposing organic matter, Drawdown, Long Lake, *Washington.

The respective roles of sediment and aquatic macrophytes in contributing to high phosphorus and algal content during the summer in a shallow, eutrophic lake were investigated. The 137 ha lake studied, Long Lake in western Washington, has a mean depth of 2 meters and a rather high flushing rate ranging from 3.6 to 8.0/yr. The water is soft, with alkalinity ranging from 20 to 40 mg/liter as calcium carbonate. Short-term water and phosphorus budgets were calculated for about 2 week intervals from 1976 through 1980. Results from P distribution in the lake and sediment core analyses implicate sediments as the major source of internal P loading during the summer months. Macrophyte mining of P removes AI-P (total available inorganic P) and enriches the organic P fraction in the surface sediment, thereby decreasing the AI-P pool. Anaerobic release of P was not considered significant in this lake, as stratification does not occur and oxygen depletion near the sediment has not been noted. Instead, at high pH, substantial release of P occurs from Long Lake sediment. As a component of a restoration program, the lake was drawn down nearly 2 meters for 4 months during the summer and fall of 1979, resulting in an 84% reduction in macrophyte biomass in 1980 but only minimal sediment consolidation. Winter decomposition of the much smaller macrophyte crop apparently provided insufficient phosphorus in the spring to stimulate phytoplankton and to enrich midlake sediments, which probably occurred in previous years. During the summer of 1980 internal loading of phosphorus was reduced and total phosphorus remained below 50 micrograms/liter. (Baker-FRC)
W82-06663

BATHYMETRY AND AQUATIC PLANTS OF LAKE WARAMAUG, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp.
Geological Survey Open-File Report 81-477 (WRI), 1981. 1 Sheet, 3 Ref.

Descriptors: *Maps, *Bathymetry, *Lakes, *Aquatic plants, Lake morphometry, Fathometers, Sounding, Data collections, Sampling, *Connecticut, Lake Waramaug.

The Bathymetry of Lake Waramaug is shown at 5-foot intervals, and the location and identification of significant concentrations of aquatic plants is indicated. The bathymetry shows the lake to be relatively steep-sided and flat-bottomed, with a maximum depth of between 40 and 45 feet. Aquatic plants were confined to the edges of the lake in depths of less than 15 feet. Nine species of aquatic plants occcur in significant numbers in the lake. Lake bathymetric data were collected using a recording fathometer and sounding rod; aquatic plant data were collected by visual survey; and the collection of samples using a weed rake. (USGS)
W82-06678

ONE-DIMENSIONAL RESERVOIR-LAKE TEMPERATURE AND DISSOLVED OXYGEN MODEL,
Geological Survey, NSTL Station, MS. Water Resources Div.
L. B. House.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-200 726, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-5, 1981. 114 p, 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Computer models, *Forecasting, *Dissolved oxygen, *Water temperature, Lakes, Reservoirs, Documentation, Thermal stratification, Oxygen demand, Heat transfer, Vertical distribution, Mixing, Selective withdrawal, Reservoir releases.

This report describes and documents a one-dimensional computer model that predicts dissolved-oxygen and temperature profiles in a lake or reservoir. Downstream release dissolved-oxygen concentrations and temperatures also are computed based on a user-specified outflow withdrawal elevation. The model can, therefore, be used to compare top-draw versus bottom-draw outlet configuration effects on downstream dissolved-oxygen and temperature conditions. The dissolved-oxygen and temperature profiles are computed for a conceptual vertical water column located at the deepest point in the lake or reservoir. The water column is divided into a series of uniform thickness horizontal layers for computation purposes. The model operates on a daily simulation interal, with summary output given for each day and detailed depth profiles printed on user-specified days. Model options allow the simulation of 5-day biochemical oxygen demand, sediment oxygen demand, and the density current effects of inflowing suspended sediment. The model is a modification of the U.S. Army Corps of Engineer's 'WESTEX' model number 722-F5-E1011. The user-specified withdrawal elevation, dissolved oxygen, biochemical oxygen demand, sediment oxygen demand, and suspended sediment simulation capabilities were not present in the earlier 'WESTEX' model. The model is capable of simulating a stratified reservoir pool environment. (USGS)
W82-06687

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. R. Have, G. A. Payne, and M. A. Ayers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-219235, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-40, 1981. 38 p, 12 Fig, 10 Tab, 27 Ref.

Descriptors: *Limnology, *Lakes, *Water quality, *Environmental effects, Chemical properties, Biological properties, Physical properties, Water sampling, Water analysis, Data collections, Eutrophication, Cyanophyta, *Minnesota, Apple Valley, Alimagnet Lake, Farquar Lake, Long Lake.

Alimagnet, Farquar, and Long Lakes, in Apple Valley, Minn., were sampled from 1973-79 to determine their physical and chemical characteristics. A storm-sewer inlet to Alimagnet Lake was also sampled during two storms in 1978. The 1976-77 drought caused a more noticeable effect on the quality of the lakes than any other factor. Chloride concentrations were 10 to 15 milligrams per liter before the drought, but increased 2 to 4 times during the drought. Dissolved solids reacted similarity. Dissolved oxygen and pH were governed mainly by biological activity. In February 1977, dissolved-oxygen concentration was less than 0.5 milligrams per liter in the three lakes. Ratios between mean total nitrogen and mean total phosphorus ranged from 22:1 to 26:1. Trophic-state indices indicate that the lakes are eutrophic. Blue-green algae dominated the phytoplankton populations. Storms sampled at a storm-sewer inlet to Alimagnet Lake showed higher concentrations of chromium, copper, nickel, and zinc than of lead, arsenic, cadmium, and mercury. Total phosphorus for the September 1978 storm had a concentration of 1.7 milligrams per liter, which means that approximately 29 pounds entered the lake during the 5.5-hour sampling period. (USGS)
W82-06690

50 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (50 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
For primary bibliographic entry see Field 5G.
W82-06716

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,
Massachusetts Univ., Boston. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06720

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,
Washington Univ., Seattle. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5C.
W82-06746

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5C.
W82-06749

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,
Kumaun Univ., Nainital (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),
For primary bibliographic entry see Field 5C.
W82-06765

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,
Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W82-06779

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METHANE FLUX IN THE GREAT DISMAL SWAMP,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. C. Harriss, D. I. Sebacher, and F. P. Day.
Nature (London), Vol 297, No 5868, p 673-674, June 24, 1982. 1 Fig, 33 Ref.

Descriptors: *Methane, *Swamps, Peat bogs, Bogs, Sinks, Atmosphere, Wetlands, Marshes, Cycling nutrients, *Great Dismal Swamp, *Virginia.

A study was made of plant ecology, soils and nutrient cycling in the Great Dismal Swamp, Virginia. This study provided an opportunity to examine ecological and climatological factors in relation to temporal variations in methane flux. All of the methane flux measurements reported were taken in a maple-gum habitat. Seasonal inundation of the maple-gum habitat varied in depth and frequency, reflecting local rainfall. All fluxes reported were obtained from soil or water surfaces without vegetation in open or closed sampling chambers. Measured emissions of methane from waterlogged soils to the atmosphere ranged from a low of .0013 g methan/sq m/day in December to a high of 0.0197 g methane/sq m/day in April. From September to December, the methane emission rate decreased as soil temperature decreased. During March and April, the methane emission rate increased as soil temperature increased. It is suggested that microbial activity in the soil profile is stratified, with methane oxidizing microorganisms living in the shallow aerobic surface layer and methane producing microorganisms living at depth in an oxygen depleted habitat. Methane fluxes to the atmosphere from maple-gum peat soils in the Dismal Swamp were generally lower than flux rates measured for other wetland soils. During the reversal of the flux from July 1980 to February 1981, the Great Swamp acted as a sink for atmospheric methane. Methane removal from ambient air over the soil surface is associated with drought conditions. The water table dropped below the bottom of the surface peat, producing a relatively dry, porous soil. From October 1980 to February 1981 the methane flux from the atmosphere to the soil decreased as soil temperature decreased. These findings raise questions concerning the generally accepted estimates of global methane emissions from wetlands and the assumption that soils are not a significant sink for atmospheric methane. (Baker-FRC)
W82-06840

RESERVOIR WATER QUALITY SAMPLING DESIGN,
Ford, Thornton, Norton and Associates, Ltd., Vicksburg, MS.
K. W. Thornton, R. H. Kennedy, A. D. Magoun, and G. E. Saul.
Water Resources Bulletin, Vol 18, No 3, p 471-480, June, 1982. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Reservoirs, *Water quality sampling, *Sampling, *Water sampling, Gradients, Monitoring, Lakes, Limnology, *Arkansas, DeGray Lake.

Several differences are described between reservoirs and lakes, and their influence on sampling design is discussed. A comparison of 309 natureal lakes and 107 reservoirs has indicated that the reservoirs had greater drainage and surface areas, drainage/surface area ratios, mean and maximum depths, shoreline development ratios, and areal water loads than did natural lakes. Reservoirs also had shorter hydraulic residence times and lower total phosphorus and chlorophyll concentrations, despite higher total phosphorus and nitrogen loadings. Reservoirs also exhibited pronounced longitudinal gradients, a phenomenon not unexpected considering the importance of advective and unidirectional transport in reservoirs. Intensive water quality transect samplings were conducted on DeGray Lake, a reservoir located in southern Arkansas, to describe and characterize lateral, longitudinal, and vertical water quality gradients. DeGray Lake exhibited marked longitudinal and vertical variation during all sample trips. Longitudinal variations were attributed to the existence of gradients from head water to dam. Turbidity and total phosphorus concentrations in the epilimnion, metalimnion, and hypolimnion decreased with the distance downstream during all trips. Epilimnetic chlorophyll a concentrations were lower and similar for all transects during the January sampling, but decreased in a downstream direction in July and October. The identification of the general location of gradients prior to the initiation of a montoring program would allow logical positioning of sampling stations. The sampling program design should be reviewed at least on an annual basis. (Baker-FRC)
W82-06868

PHYSICAL PROCESS AND EUTROPHICATION,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5C.
W82-06878

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,
Kinnert Limnology Lab., Tiberias (Israel).
S. Serruya, and E. Hollan.
Archiv fur Hydrobiologie, Vol 92, No 2, p 137-160, September, 1981. 14 Fig, 5 Tab, 7 Ref.

Descriptors: *Lakes, *Oscillatory waves, *Seiches, Waves, Lake Kinneret, *Israel, Management, Surface water, Coriolis force, Water level, Water level fluctuations, Water management.

Using the two-dimensional theory of Rao and Schwab, the lowest 10 normal modes of Lake Kinneret were determined. The calculations were carried out neglecting the Coriolis force, which is of minor influence on the oscillations due to the medium size of the lake. The lake itself is roughly elliptic, with a longitudinal axis of 22 km in the north-south direction and a transverse axis of 12 km length. The maximum depth of the lake is 43 meters and the mean depth is 25.6 meters. During late winter and spring, when highest water levels usually occur, the free oscillation on the lake can contribute to inundation damage, mostly during stormy periods of easterly wind which are then dominant. For a future option of lake management the normal modes have also been calculated for a water level lowered by 4 meters, 15.7% reduction of the lake's volume. The theoretical periods were verified by spectral analysis of 26 cases of observed water level fluctuations. Verification of the calculated structure was only partially achieved due to the scarcity of existing simultaneous measurements. The structures of the normal modes are discussed in detail in terms of their character, their location of nodal lines and the distribution of relative elevations. (Baker-FRC)
W82-06879

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,
Academy of Natural Sciences of Philaelphia, PA.
For primary bibliographic entry see Field 5C.
W82-06880

KINETIC ANALYSIS OF COMPETITION BETWEEN SULFATE REDUCERS AND METHANOGENS FOR HYDROGEN IN SEDIMENTS,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
D. R. Lovley, D. F. Dwyer, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1373-1379, June, 1982. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Bacteria, *Methane bacteria, *Sulfate-reducing bacteria, Sediments, *Lake sediments, Hydrogen, Eutrophic lakes, Sulfates, *Eutrophication, Wintergreen Lake, *Michigan.

The competition between sulfate-reducing and methanogenic bacteria for hydrogen was studied during summer stratification at two sites in eutrophic Wintergreen Lake, Michigan. In the upper 0-2 cm sediment layer sulfate reduction and methane production coexisted, but methane production was the dominant terminal process. Adding 10-20 nM sulfate to the naturally low-sulfate sediments produced a decrease in H partial pressure and an inhibition of methane production. Inhibition of sulfate reduction by molybdate in the sulfate-enriched sediment increased H partial pressure and methanogenesis to the rates seen in sediments unamended with sulfate. The half-saturation constants for H uptake were 141 pascal for the sulfate-reducer population and 597 pascal for the methanogen population. Thus, in the presence of sufficient sulfate, the lower half-saturation constant of the sulfate reducers allowed them to lower H partial pressures to levels unusable by methanogens. Then sulfate was not limiting, the competition between the two bacterial populations depended on the rate of H production, relative population size, and sulfate concentration. In this lake methane bacteria successfully competed with sulfate reducing bacteria because wulfate is limited. The competition for acetate is expected to have mechanisms similar to those for H competition. (Cassar-FRC)
W82-06886

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),
University Coll. of Wales, Aberystwyth. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06895

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,
Tokyo Metropolitan Univ., (Japan). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06900

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,
Maryland Univ., College Park. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06906

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,
Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06911

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,
Oklahoma State Univ., Stillwater, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,
Water Research Lab., Columbus, OH., Div. of Water.
For primary bibliographic entry see Field 5C.
W82-06932

MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,
University of Southern California, Los Angeles, Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,
State Univ. of New York Coll. at Fredonia, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,
Ontario Ministry of the Environment, Rexale, Limnology and Taxonomy Section.
For primary bibliographic entry see Field 5C.
W82-06936

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,
Michigan Technological Univ. Houghton, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,
Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,
Ecology and Environment, Incorporated, Buffalo, New York.
For primary bibliographic entry see Field 5C.
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,
Limnos Limited, Toronto, Ontario.
For primary bibliographic entry see Field 5C.
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,
Indiana Univ., Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06943

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,
Wisconsin Univ.-Milwaukee, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06976

COMPARATIVE PHOTOHETEROTROPHY, CHEMOHETEROTROPHY, AND PHOTOLITHOTROPHY IN A EUTROPHIC RESERVOIR AND AN OLIGOTROPHIC LAKE,
North Texas State Univ., Denton. Dept. of Biological Sciences.
B. K. Ellis, and J. A. Stanford.
Limnology and Oceanography, Vol 27, No 3, p 440-454, May, 1982. 6 Fig, 2 Tab, 43 Ref.

Descriptors: *Microbiological studies, Lakes, Reservoirs, *Eutrophication, *Oligotrophic lakes, Oligotrophy, Trophic level, Microorganisms, Plankton, Seasonal variation, *Lake Texoma, Algae, *Texas, *Oklahoma.

The relative contributions of various organisms to photolithotrophic, chemoheterotrophic, and photoheterotrophic activities in plankton of two sizes in two diverse lentic systems were investigated. The study site was Lake Texoma, a eutrophic impoundment of the Red and Washita Rivers in Texas and Oklahoma, and Flathead Lake, a deep, glacial lake on the Flathead River in northwestern Montana. Lake Texoma is a monomictic reservoir with a surface area of 359.6 square kilometers and a depth of 35 meters. Ultraplankton dominated plankton numbers and metabolic activity in both systems. An increase in photolithotrophy during the fall was due to an increase in the activity, numbers/ml or both of specific phytoplankters rather than an increase in the percentage of viable cells. Many of the most abundant species were not the most productive in terms of inorganic C fixation. Single species dominated total inorganic C fixation in both systems. Light mediated uptake of glucose was extensive in Flathead Lake. Light bottle uptake averaged 365% of dark bottle uptake. Autoradiographs indicated that bacteria were responsible for the observed light-mediated uptake of glucose in both lakes. Chemoheterotrophy dominated all Lake Texoma samples. Simultaneous in situ $NaHCO_3$ and glucose incubations in Lake Texoma revealed an ability of Oscillatoria agardhii (Gomont) to be mixotrophic as well as photoheterotrophic. (Baker-FRC)
W82-06978

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,
Utah State Univ., Logan. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,
All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 5C.
W82-06982

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06991

2I. Water In Plants

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 6B.
W82-05966

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2 p 372-376, March/April, 1982. 3 Fig, 4 Tab, 23 Ref.

Descriptors: *Crop yield, *Irrigation, *Reservoir storage, Model studies, *Corn, Reservoir design, Soil-water-plant relationships, Rainfall-runoff, relationships, Hydrologic models, *Supplemental irrigation, *Kentucky, Watershed management.

A watershed runoff model and a corn yield model were combined to describe corn yields as a function of reservoir size. Components of the model were; crop growth-soil function, water supply function-runoff model, reservoir water balance-reservoir sizing routine, site characterization, and climatic simulation. A hypothetical farming operation was simulated, assuming a 100 acre corn planting and 300 acre watershed in central Kentucky. A series of probability curves (corn yield vs. reservoir storage volume) were produced. For this example, a 6000 cu m reservoir would allow yields of 8000 kg per ha or greater 96% of the time. (Cassar-FRC)
W82-05967

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
G. S. Chaturvedi, P. K. Aggarwal, and S. K. Sinha.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 738-745, October, 1981. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Water stress, Plant growth, *Barley, Irrigation, Irrigation requirements, Moisture stress, Crop yield, Moisture availability, Stress, *Wheat, *Triticale, *India.

The response of flag-leaf and other leaves to water availability was studied in several cultivars of Triticum aestivum Linn. emend. Thell., T. durum Desf., triticale and Hordeum vulgare Linn. emend. Bowden. Twenty-one cultivars were grown in the field under two moisture regimes: no irrigation versus five irrigations at different growth stages comprising crown-root initiation, jointing, booting, flowering, and grain filling. The stability of the flag-leaf size in relation to water stress was assessed. The findings indicate that in comparison with other leaves the size of the flag-leaf in different groups, and the flag-leaf size did not show the capacity to recover from the adverse effect of early stress even when water availability was adequate during the later growth period. Stress-induced reduction in flag-leaf was compensated by an increase in photosynthesis rate, as suggested by the increase in specific leaf weight. Considerable variability apparently exists in this respect within each of the groups. (Baker-FRC)
W82-05972

EFFECTS OF IRRIGATION FREQUENCY ON GERMINATION AND ON ROOT AND SHOOT YIELDS OF ACACIA SPECIES,
Shambat (Sudan). Faculty of Agriculture.
F. F. Bebawi, and S. M. Mohamed.
Plant and Soil, Vol 65, No 2, p 275-279, 1982. 2 Tab, 6 Ref.

Descriptors: *Soil-water-plant relationships, *Semiarid lands, Arid lands, Acacia species, Irrigation, Vegetation establishment, Germination.

Two experiments were performed to determine the effects of irrigation frequency on germination of Acacia seeds and growth yield of young seedlings of Acacias. In the first study there were 5 irrigation treatments replicated 4 times, including waterlogged soil, daily irrigation, irrigation at 3 days frequency, irrigation at 6 days frequency, and no irrigation (control). In the second study there were 4 treatments replicated 3 times, comprising daily irrigation (Control) and irrigation at 2,4 or 8 day frequencies. Highly different germination responses were found between species tested. Maximum germination response was realized by A. albida and minimum by A. nilotica. Over all species there were highly different responses between irrigation treatments. Daily irrigation induced the best germination response of about 57.9%, while waterlogged soil gave the second best germination response of about 10.4%. Highly significant differences were noted in root plus shoot yields between species, treatments, and species times treatment interaction. The greatest growth yield (root plus shoot) was manifested by A. nubica, while the lowest was revealed by A. nilotica, with a growth yield difference of about 59% between them. In general species of relatively dry habits were more sensitive to water supply compared with those of relatively wet habitats. This was reflected at the establishment phase by the greater production of root plus shoot yields by species of drier zones than by those of wetter ones. It is concluded that variations in water supply may account for species

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adaptation and distribution in semi-arid zones. (Baker-FRC)
W82-06229

EFFECT OF WATER MANAGEMENT AND BED HEIGHT ON SUGARCANE YIELD,
Science and Education Administration, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
C. R. Camp.
Soil Science, Vol 133, No 4, p 232-238, April, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Water table, *Drainage effects, *Soil water table, *Sugarcane, Crop yield, Water management, *Louisiana, Subsurface drainage.

Sugarcane was grown in Mhoor silty clay loam in Louisiana under three water management regimes and two bed heights from 1973 to 1976. The three water management treatments were: (1) subsurface drainage with the water table at least 1.5 m below the surface, (2) water table maintained constant at 0.3 m below the surface, and (3) no subsurface drainage and variable water table responding to rainfall. The two bed heights were flat and 0.3 m high. Rainfall frequency and amount varied widely over the experimental period. Yields were adversely affected in flat beds during wet years. However, in the dry year flat bed planted sugarcane produced higher yields than raised beds. A water table depth of 0.3-1.5 m produced the best yields. During the wet years subsurface drained treatments gave significantly higher yields than the high, constant water table and variable water table (undrained) treatments. During the dry year the high, constant water table treatment produced higher yields than the low and variable water table treatments. (Cassar-FRC)
W82-06231

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 2D.
W82-06320

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson.
Water Resources Research, Vol 18, No 2, p 325-340, April, 1982. 1 Tab, 20 Fig, 34 Ref.

Descriptors: *Soil environment, *Plant-water potentials, Mathematical studies, *Canopy, *Atmosphere, *Transpiration, Runoff, Climate, Porosity, Field investigations, Water yield, *Optimization, Systems analysis, Equilibrium, Prediction.

The literature concerning ecological optimality of natural soil-vegetation systems has been reviewed and used as a guide to formulate hypotheses governing the equilibrium of water-limited systems with respect to canopy density, species water use, and hydraulic properties of the soil. A statistical-dynamic water balance is used to quantify these hypotheses. In moist climate-soil systems the soil moisture becomes insensitive to vegetation changes and can be maximized only with respect to canopy density. In humid systems the species may be subject to ecological pressure for longer-term change toward higher biomass productivity. These hypotheses result in a relationship specifying the time average evapotranspiration efficiency of landsurfaces given only the density of the vegetation canopy, a water table parameter, and a surface retention parameter. This relationship is independent of the soil properties and could produce estimates of the water and heat balances given only the properties of the climate. Combination of short-term optimal canopy density and long-term optimal biomass productivity can lead to specification of the climax vegetation canopy density and the species water use coefficient, as well as some hydraulic properties of the soil. If verified, these hypothesized relations should help in the design of land-reclamation. (Titus-FRC)
W82-06321

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 2. TESTS AND APPLICATIONS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson, and T. E. Tellers.
Water Resources Research, Vol 18, No 2, p 341-354, April, 1982. 7 Tab, 19 Fig, 28 Ref.

Descriptors: *Soil environment, *Plant water potentials, Mathematical studies, *Canopy, *Optimization, Systems analysis, Atmosphere, Climate, Runoff, Transpiration, Porosity, Field investigations, Prediction, Equilibrium, California, Massachusetts.

Tests to verify correlations between canopy density and species water use in various climates were conducted. Field observations were made at sites in Massachusetts and California. The long-term optimal climatic soil-vegetation system is defined in terms of effective porosity and plant water use, and a relationship between average evapotranspiration and optimum vegetation canopy density is derived and compared with the field observations. It was found that the predicted water balance behavior is in reasonable accord with observations. However, more research is needed, particularly for arid climates. (Titus-FRC)
W82-06322

WATER STRESS OF FOUR WINDBREAK TREE SPECIES DURING SOIL DRYING,
Northern Great Plains Research Center, Mandan, ND.
A. B. Frank.
Journal of Soil and Water Conservation, Vol 37, No 3, p 189-192, May/June, 1982. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Windbreaks, Shelterbelts, *Trees, Crops, Available water, *Soil moisture deficiency, Moisture deficiency, Green ash, Hackberry, American elm, Siberian elm, *Northern Great Plains.

Water is a major limiting factor to plant growth in the Northern Great Plains. Windbreak trees are thus susceptible to severe water stress. Stress occurs when water uptake through the roots cannot keep pace with transpiration. The rate of stress development differs among species. Water relations for green ash, hackberry, American elm, and Siberian elm trees were evaluated to determine the response to increasing soil water deficits and to relate results to field observations on competition among trees and adjacent crops and to tree growth characteristics. Leaf water potentials of green ash and hackberry, in comparison with American and Siberian elm, declined at different rates during a 2 year field study. From the initial sample data at full leaf expansion to thefinal sample data at leaves senescencing, leaf water potential dropped 30.1 bars for green ash and 27.9 bars for hackberry. These reductions compared with 10.1 and 6.2-bar reductions for American and Siberian elm, respectively. In a controlled-environment chamber, transpiration rates at high soil water potentials were considerably higher for Siberian elm than for green ash or American elm. The higher water stress in leaves of green ash and hackberry contributed to early growth cessation and leaf drop during late summer, which should reduce total soil water use by the trees and leave more water for adjacent crops. If Siberian elm were selected for early leaf drop, it would probably initiate hardening processes earlier and impart greater tolerance to winter injury and stress-related disease and insect attack. (Baker-FRC)
W82-06793

2J. Erosion and Sedimentation

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,
Wisconsin Univ.- Madison. Dept. of Geography.
For primary bibliographic entry see Field 4D.
W82-05931

DEPOSITIONAL MODEL FOR A CHENIER PLAIN, GULF OF CARPENTARIA, AUSTRALIA,
Australian Inst. of Marine Science, Townsville.
E. G. Rhodes.
Sedimentology, Vol 29, No 2, p 201-221, April, 1982, 13 Fig, 2 Tab, 67 Ref.

Descriptors: *Sedimentation, *Coastal plains, *Ridging, Tidal flats, Progradation, Chenier plains, Gulf of Carpentaria, *Australia, Runoff, Alluvial plains, Rainfall, Sediment transport.

A chenier plain (widely separated coastal ridges oriented nearly parallel to the modern coast and spread over a broad plain) in the Gulf of Carpentaria, Northern Australia, has prograded over 30 km since the Middle Holocene. This was caused by deposition of low tide muds over subtidal muds during periods of increased sediment input by rivers. The plain, extending for 150 km, consists of a series of discontinuous shell ridges resting on muddy substrates. Upland tree species grow on the ridges. Between the ridges are unvegetated mud flats or thinly vegetated clay dunes. The chenier ridges, formed during periods of reduced sediment flux by wave induced sorting and redistribution, reflected the increases and decreases in sediment flux from the rivers as a result of temporal fluctuations in rainfall over the watershed draining into the gulf. Techniques used to study the plain were core samples, geomorphic mapping, and radiocarbon dating. These findings reinforced the traditional explanations of chenier plain development. (Cassar-FRC)
W82-05957

BED-MATERIAL SIZE AND THE RIFFLE-POOL SEQUENCE,
Newcastle upon Tyne Univ. (England). Dept. of Geography.
J. A. Milne.
Sedimentology, Vol 29, No 2, p 267-278, April, 1982. 10 Fig, 4 Tab, 34 Ref.

Descriptors: *Bed sediment, *Particle size, *Riffles, Sedimentation, Streams, Sediment distribution, Sediment sorting, Gravel, Channel morphology, *Scotland, Kinglesdoors Burn.

Relationships between bed material characteristics and local riffle-pool oscillations along a channel are described. The stream examined was Kinglesdoors Burn, a small gravel bed stream in upland Scotland. The downstream sequences of bed material size were highly variable and showed no trend except for slight persistence in data over distances of 1-1.5 channel width. Riffles tended to coincide with coarser bed material sequences. Mean particle size was the most useful criterion for distinguishing between bed forms, bars being the most distinctive features. Riffles and pools were considered as downstream oscillations in elevation of a single coarser gravel sedimentary unit. Plan geometry and coarse sediment supply also influenced bed material size distributions. Tightly curved pools had the finest pool sediments and the least difference between bar and pool sediments. Larger sizes of materials in pools were negatively correlated with the index of cross section asymmetry. (Cassar-FRC)
W82-05958

QUANTITATIVE RELATIONSHIPS BETWEEN NUMBERS OF FLUVIAL CYCLES, BULK LITHOLOGICAL COMPOSITION AND NET SUBSIDENCE IN A SCOTTISH NAMURIAN BASIN,
Institute of Geological Science, London (England).
W. A. Read, and J. M. Dean.
Sedimentology, Vol 29, No 2, p 181-200, April, 1982. 9 Fig, 4 Tab, 57 Ref.

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Descriptors: *Sedimentary basins, *Fluvial sediments, *Subsidence, Sedimentary rocks, Alluvial deposits, Sedimentology, Sedimentation, Sand, Stratigraphy, Geology, *Scotland, Rivers, Kincardine Basin.

Fluvial deposits in the subsiding Namurian Basin, Kincardine Basin in the Midland Valley of Scotland, were studied as a background for future computer simulation experiments and for comparison with other ancient basins. The succession of rock strata under investigation consisted almost entirely of fluvial deposits. More than 94% of the semicycles containing sand were upward-fining, leading to the conclusion that rivers were dominantly meandering. The numbers of rooting horizons and grain-size cycles and the total thicknesses of sandstone and mudstone-siltstone showed a linear relationship with the total thickness of strata and net subsidence. The average thickness of grain-size cycles showed trends toward an inverse linear relationship with net subsidence, reflecting the presence of thin stacked channel fills within persistent channel belts. These belts were localized in areas of greatest subsidence in the basin and followed courses similar to channels in the underlying delta sediments. Sand was most commonly found at points on the margin where channels entered the basin from the northwest and northeast and left to the southwest. Mudstone and siltstone were on the flanks of the basin. Coal seams were found on the flanks of the basin. The rooting horizons were most numerous in areas of low subsidence remote from main channel belts. (Cassar-FRC)
W82-05959

SPLASH EROSION MODELING: PHYSICAL ANALYSIS,
Illinois Univ., Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, J. K. Mitchell, and G. G. Bubenzer.
Transactions of the ASAE, Vol 25, No 2, p 357-361, March/April, 1982. 4 Fig, 20 Ref.

Descriptors: *Erosion, *Splash erosion, *Rain, Soil erosion, Model studies, Impact velocity, Water depth, Slopes, Interril erosion.

The splash erosion process was expressed mathematically using dimensional analysis. It is generally limited to interrill areas where erosion takes place within two different domains, drop-solid and drop-liquid-solid. The drop-solid domain was described with analytical relationships from the law of conservation of momentum. The drop-liquid-solid domain was characterized using the ratio of water depth to drop diameter. The models considered raindrop, sediment, and system parameters affecting splash erosion. Experimental data from the literature were used to evaluate the effects of various parameters affecting splash erosion. When drops were too small or their impact velocity was to low to overcome the inertia of the soil particles, no splash erosion occurred. Splash erosion increased slightly to a critical water depth of about 1 drop diameter and decreased sharply as the water depth increased beyond that point. Splash erosion was time-dependent. The horizontal displacement of sediment increased linearly as the slope angle increased, but the vertical displacement decreased nonlinearly with slope. It is possible that the effects of Froude number may be appreciable. (Cassar-FRC)
W82-05970

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,
Caulfield Inst. of Tech., Caulfield (Australia), Water Studies Centre.
For primary bibliographic entry see Field 5B.
W82-06054

CHANGES IN BOTTOM TOPOGRAPHY OF THE WESTERN SHELF ON THE NILE DELTA SINCE 1922,
National Research Center, Cairo (Egypt).
S. A. Toma, and M. S. Salama.
Marine Geology, Vol 36, No 3/4, p 325-339, July, 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Topography, *Deltas, *Nile Delta, Aswan High Dam, Dams, Bathymetry, Sediments, Rivers, Flow discharge, Sediment discharge, Erosion, Sediment distribution, Bottom sediments, Geomorphology, Continental shelf, Mediterranean Sea.

Significant changes have been noted in bottom morphology of the western continental shelf of the Nile Delta since 1922. Most of these changes were already in progress before the completion of the Aswan High Dam in 1964. The Rosetta Canyon appears to influence bottom currents and the pattern of bottom-sediment distribution. The water flow and sediment flow discharged from the Rosetta mouth toward the Rosetta canyon overcomes the current flow to the east, which prevails, or to the west, which also occurs. Thus the Rosetta Canyon serves as a sink for the eroded sediments transported offshore from Abu Quir Bay and the Rosetta fan. For sand movements on the Burullus shelf, the bottom-current velocities are of minor magnitude and only capable of transporting fine-grained material. Wave-induced currents must be the energy source for sand movements on the shelf. Stormy weather conditions are of prime importance. It is suggested that net erosion in the area off the Rosetta mouth and the retreat of the adjacent coastline probably reulted from the drastic decline of sediment on completion of the Aswan High Dam. (Baker-FRC)
W82-06094

THE ROLE OF THE AKOSOMBO DAM ON THE VOLTA RIVER IN CAUSING COASTAL EROSION IN CENTRAL AND EASTERN GHANA (WEST AFRICA),
Ghana Univ., Legon. Dept of Geology.
C. K. Ly.
Marine Geology, Vol 37, No 3/4, p 323-332, September, 1980. 9 Fig, 4 Ref.

Descriptors: *Erosion, *Dams, *Volta River, West Africa, *Ghana, Sediment discharge, Sediments, Sand, Rivers, Topography, Shore protection, Shores, Coasts, Erosion rates, *Beach erosion.

Since the building of the hydroelectric dam on the Volta River at Akosombo, West Africa, the supply of sand from the river has been greatly reduced. Whether this reduction in sand contributes to the erosion of the coast of Ghana has been investigated. About 99.5% of the river drainage basin is blocked by the dam. Comparisons were made of the average rates of shoreline retreats as determined from aerial photographs and maps during the periods before and after dam construction. The shoreline of central and eastern Ghana appears to be characterized by a general recession. This recession was not extensive on the western portion of the central coast between Cape Three Points and Winneba, where there are many protruding rock headlands. Shoreline recessions on the order of 2 to 6 meters per year are experienced on many remaining parts of the coast. The rate of shoreline recession to the west of the Volta River has remained constant before and after dam construction and thus is apparently not influenced by the dam. Since dam construction there has been a general increase in shoreline recession rates to the east of the Volta River, caused by reduction of sand supply from the river following dam construction. (Baker-FRC)
W82-06100

MINERALOGICAL INPUT OF SUSPENDED MATTER BY INDIAN RIVERS INTO THE ADJACENT AREAS OF THE INDIAN OCEAN,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian.
Marine Geology, Vol 36, No 3/4, p M29-M34, July, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Sediment transport, *Rivers, *Indian Ocean, Sediments, Minerals, Mineralogy, Oceans, Kaolinite, Illite, Quartz, Fluvial sediments, Sediment discharge, Suspended sediments, Bay of Bengal, Arabian Sea, Rivers.

Preliminary results are reported on the mineralogy of suspended sediments at the mouths of the Ganges, Brahmaputra, Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers and their relationship to the reported mineralogy of bed sediments in the Bay of Bengal and the Arabian Sea. The data suggest that kaolinite, illite, and chlorite are carried in suspended particulates of the Ganges-Brahmaputra, while the southern rivers carry high amounts of montmorillonite and small amounts of mixed-layer clays to the Bay of Bengal. The presence of montmorillonite and mixed-layer clays in the suspended sediments of the Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers would support the observations made earlier about a montmorillonite belt surrounding India. On the western coast of India, the Narmada and Tapti Rivers contribute abundant chlorite, illite, and kaolinite, and minor amounts of montmorillonite. The four southern rivers, Mahanadi, Godavari, Krishna, and Cauvery, are characterized by the absence of chlorite, abundance of montmorillonite, and presence of trace amounts of mixed-layer clays and small Jamuna, are characterized by the presence of large amounts of illite, equal quantities of kaolinite and chlorite, and little or no mixed-layer clays and montmorillonite. Central rivers such as Narmada and Tapti have mineralogical characteristics between those of the southerly and the Himalayan drainage systems. (Baker-FRC)
W82-06102

WAVES GENERATED BY RIVER AND WIND ON THE ILLINOIS AND MISSISSIPPI RIVERS,
Illinois State Water Survey, Urbana.
N. G. Bhowmik, M. Demissie, and C-Y. Guo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254897, Price codes: A05 in paper copy, A01 in microfiche.
Illinois Water Resources Center, Urbana, WRC Research Report No 167, March 1982. 90 p, 33 Fig, 11 Tab, 33 Ref. OWRT A-104-ILL(1), 14-34-0001-0115.

Descriptors: *Wind waves, *Waves, *Wave height, Rivers, *Bank erosion, *Regression analysis, Wind, Wind gages, Wind-driven currents, Translatory waves, Wave action, Wave wash, Ships, Barges, Boats, Mathematical studies, Drawdown, Illinois River, *Mississippi River.

Data on waves generated by river traffic/winds on the Illinois and Mississippi Rivers as representative U.S. waterways were collected systematically to address specific questions (the characteristics of waves from tows/barges/boats in an inland waterway; similarities/dissimilarities between these waves and those produced by natural effects; wave intensity changes as a function of increased river traffic) and the associated effect of bank erosion. The data were obtained in six field trips to four river test sites. Maximum wave heights ranged from 0.1-1.08 feet, while maximum drawdown ranged from 0.05-0169 foot. These data were compared to those expected from predictive equations, and the correlations were found to be low. However, multivariate regression analyses between measured values and hydraulic/geometric parameters which were felt to influence the generation of waves/draw downproduced two equations which predict maximum wave heights and drawdowns fairly well. In general, observed and calculated waves from river traffic and wind are both sufficient to cause stream bank erosion along the Rivers. Drawdown from loaded tows was also significant, changing flow characteristics of small tributary streams. (Zielinski-MAXIMA)
W82-06163

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center
J. P. M. Syvitski, and R. D. Macdonald
Canadian Journal of Earth Sciences, Vol 19, No 5, P 1025-1044, May, 1982. 19 Fig, 1 Tab, 38 Ref.

Descriptors: *Estuarine environment, Sediment analysis, *Sedimentation, Fjords, British Columbia, Howe Sound, Geology, Geomorphology, Squamish River, Fraser River, Copper, Zinc, Mine wastes, Sediment transport, *Canada.

Sediment pathways are traced from the following sources: glacially derived sediment from the Squamish River, suspended sediment from the nearby Fraser delta complex, reworked Pleistocene tills, and mine tailings from an abandoned copper-zinc mine. Howe Sound was chosen for the study as it is an estuary located close to a large urban population. Grain size data have been used to differentiate depositional versus nondepositional environments. In addition, surficial sediment samples collected from depositional basins could be modeled in terms of their size-frequency distribution and distance from source. Those that deviate from a predicted grain size distribution were found to be bimodal. Partitioning of their probability curves allowed the establishment of mixing ratios of the major sediment sources, and indicated that the Squamish-derived sediment accounted for between 80 and 100% of recent Howe Sound deposition. Semi-Quantitative X-ray diffraction analysis results can resolve the dispersion directions of each source and show that mica can be used to trace the Squamish sediment source, the chlorite pattern indicates the Fraser sediment source, and quarts is useful in delineating pathways of sediment resuspended from lag deposits. These pathways are also substantiated by gradients in copper, nickel and zinc concentrations in the sediments. Such studies are useful for areas such as this one which is too complex to model in terms of water circulation. (Baker-FRC)
W82-06189

ORIGIN OF STEP-POOL SYSTEMS IN MOUNTAIN STREAMS,
Lincoln Coll. (New Zealand). Dept of Agricultural Engineering.
J. G. Whittaker, and M. N. R. Jaeggi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 758-773, June, 1982. 5 Fig, 4 Tab, 52 Ref.

Descriptors: *Streambeds, *Stable channel, *Sediment transport, Stream stabilization, Stream erosion, Antidunes, Step-pool systems, Mountain streams, Erosion, Riffles, Deformation, Sediment sorting.

A tilting laboratory flume and a graded sediment (2-50- mm particle size) were used to study the mechanisms of step-pool formation in steep mountain streams. In highly sloped beds (.0.075), step-pool structures formed during high flow by an initial bed deforming process. The heterogeneity of the sediment caused formation of a coarse armored layer, resistant to deformation. This formed a stream bed which was very stableat low flow. At slopes <0.075, high flow formed antidunes. When the flow was reduced, the streambed had a riffle-pool appearance. (Cassar-FRC)
W82-06335

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,
San Diego State Univ., CA.
H. H. Chang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 678-689, May, 1982. 5 Fig, 15 Ref.

Descriptors: *Channel erosion, *Mathematical models, *Alluvial channels, *Aggradation, *Stream degradation, *Stream erosion, Channel flow, Erosion, Sedimentation, Stream profiles, Stream beds, Model studies.

A mathematical model was developed for predicting morphological changes in erodible channels while accounting for alterations in both channel width and bed profile of aggrading and degrading streams. The model employs methods for water and sediment routing as well as an additional condition based on the concept of minimum stream power as the width predictor. Application of the model shows that the total stream power of a reach is reduced if the widths at all cross sections are adjusted to reduce the variation in energy gradients at these sections. A varied flow will gradually develop into a uniform flow while the stream power reaches a minimum. The model has been substantiated with field data and demonstrates the validity of the concept of minimum stream power as a physical principle governing the morphology of alluvial streams. It also furnishes a basic understanding of the changes in streams in response to various environmental and hydraulic parameters. (Geiger-FRC)
W82-06336

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
R. K. Johnson, and S. A. Schumm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256587, Price codes: A06 in paper copy, A01 in microfiche. Completion Report No 10, April, 1982. 99 p, 20 Fig, 11 Tab, 29 Ref, 1 Append. OWRT B-203-COLO(1). 14-34-0001-0210.

Descriptors: *Salinity, *Saline soils, *Sediment transport, *Water pollution sources, *Dissolved soilds, *Surface runoff, Erosion, Saltation, Salt flats, Saline water, Sedimentation, Salts, Runoff, Sediment erosion, Sediment load, Water quality, Water quality control, Sediment discharge, Pollution load, Sandstones, Shales, Colorado River, Grand Valley.

Grand Valley Mancos shale, composed of a thick sequence of interbedded shale and sandstone, is a significant contributor of dissolved solids to the upper Colorado River. Research was carried out to describe the area geomorphology and soluble mineral content relationships of surficial materials in erosionally-unstable landforms, to relate geomorphic stability to salt release processes from the area, and to recommend land use and/or salt control measures for reducing salt load alluvial valley floors, and badlands, with the latter having the greatest surface area. The badlands are the least stable landform, releasing more sediment and salt into runoff than the other landforms. Pediments are capped by cemented gravels and are the most stable landform, while the alluvial valley floors are generally also stable to sediment/salt production. Recommendations for understanding erosional and salinity characteristics of runoff from the badlands and for reducing erosion/salinity related to current land use include examining the effectiveness of existing sediment retention structures, comparing sediment load and salinity of runoff from two drainage basin lithologies, and reducing gully erosion caused by road drainage ditches/culverts. (Zielinski-MAXIMA)
W82-06364

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
For primary bibliographic entry see Field 8I.
W82-06395

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,
London Coll. (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W82-06421

SEDIMENT TRANSPORT AND UNIT STREAM POWER FUNCTION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, and A. Molinas.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 774-793, June, 1982. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Sediment transport, *Energy dissipation, *Turbulent flow, Bed load, Sediment load, Sediment concentration, Sediment discharge, Fluid mechanics, Open channel flow, Channel flow, Flow characteristics, Suspended sediment, Unit stream power, Flumes, Rivers, Steady flow, Sediment discharge, Mathematical equations.

Suspended sediment concentrations at a given depth of an open channel flow are a function of the turbulence energy production rate at that depth. This hypothesis was verified by applying basic flow mechanics and turbulence theories. By integrating the rate of turbulence energy production over depth of flow, depth-averaged suspended sediment concentration was expressed as a function of unit stream power. Total sediment concentration was also described as a function of unit stream power by the process and a procedure similar to that used by Einstein. Seven total load equations were evaluated by comparing the computed results with 1093 sets of laboratory data and 166 sets of river data. Results from equations based on the concept that the rate of sediment transport in a open channel flow is related to the rate of energy dissipation of the flow produced good agreement with measured results. This group included equations proposed by Yang, Englund, Hansen, and Ackers and White. Equations by Shen and Huang and by Maddock, which lacked depth parameters, were applicable to laboratory flumes and small streams but not to large rivers. The Colby method underestimated total bed load material loads in natural rivers and was not suitable for laboratory flumes. (Cassar-FRC)
W82-06424

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,
Army Engineer District, St. Louis, MO.
G. R. Dyhouse.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 399-418, March, 1982. 15 Fig, 9 Ref.

Descriptors: *Urban watersheds, *Urbanization, *Sedimentation, *Urban runoff, Storm runoff, Land use, Prediction, Mathematical models, Dredging, Sediment discharge, Flood plains, Sediment transport, Computer programs, St. Louis, *Missouri, *Illinois.

Preconstruction planning for the Harding Ditch portion of the East St. Louis, Illinois and Vicinity Interior Flood Control Project, which is the main drainage canal for two urbanizing watersheds near St. Louis, Missouri, required an analysis of sediment deposition under current and future land use conditions and of the efects of channel modifications on the sediment regime and on the frequency and quantity of dredging required to maintain a larger channel. A grid cell data bank was used to break down each watershed by land use category and to establish the percent of the watershed in each category. Four major computer programs or methods were used to model mass runoff of water and sediment from the watersheds and deposition-erosion along Harding Ditch for existing and future (2020) land use conditions. Estimates of sediment washoff parameters for each land use category were used to compute hourly values of discharge and tons of sediment washoff per event from each watershed for 20 years of rainfall data for existing and future land use. Comparison of the current and future thalweg profiles indicated that future land use conditions will result in less sediment deposition as more and more erodable soil is covered by impervious material. If upstream erosion control measures are instituted during the construction process, any downstream depositional problems should be reduced further. Although periodic dredging will be needed to maintain the required channel geometry for any channel modification project, dredging at 10-year intervals should be sufficient to maintain a with-project rating curve relationship. (Carroll-FRC)
W82-06426

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESU-

SPENSION IN THE EASTERN BASIN OF LAKE ERIE,
Eidenossische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewasserschutz, Zurich (Switzerland).
J. Bloesch.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 748-759, May, 1982. 7 Fig, 8 Tab, 27 Ref.

Descriptors: *Sediment transport, *Lake sediments, *Lake Erie, *Sedimentation rates, *Model studies, Sediments, Sedimentation, Sediment distribution, Suspended sediments, Particulate matter, Organic carbon, Nitrogen, Phosphorus.

Sediment traps moored at three stations along an inshore-offshore transect in the Eastern Basin of Lake Erie from June to October of 1978 were used to examine differences in sedimentation processes of the near-shore and offshore environments in terms of dry weight, particulate organic carbon (POC), particulate nitrogen (PN) and particulate phosphorus (PP). Settling fluxes recorded at traps close to the lake bottom were nearly the same at all three stations during the summer stratification. At the offshore monitoring site, a comparison of the hypolimnetic traps with the epilimnetic traps showed that considerable resuspension takes place even in the summer. During the fall, however, storm-induced bottom resuspension resulted in higher nearshore sedimentation rates. A resuspension model for dry weight, POC, and PN was developed by comparing trap catches with sediment cores from all three stations. Data showed that newly formed organic material is resuspended and redeposited more frequently at nearshore locations than offshore, thus enhancing decomposition of detritus, as indicated by the low relative phytoplankton activity in the hypolimnetic traps. These cycles cause horizontal transport of fine-grained organic matter in the offshore direction and explain the significant POC and PN concentration differeces observed in the inshore and offshore sediments. (Geiger-FRC)
W82-06494

SUSPENDED SEDIMENT IN A WAVE FIELD,
Canada Center for Inland Waters, Burlington (Ontario).
M. G. Skafel, and B. G. Krishnappan.
Atmosphere-Ocean, Vol 19, No 3, p 274-278, 1981. 5 Fig, 3 Ref.

Descriptors: *Suspended sediments, *Sediment transport, *Wave action, Shear, Photography, Vortices.

A series of photographs illustrate the ripple form and the kinematics of suspended sediments in a wave field. Experiments were conducted in a wave flume in which sieved glass beads covered the bottom. Water depth was 0.15 m, wave period was 1 sec, wave height was 55 mm, mean ripple length was 37 mm, and mean ripple height was 4.6 mm. No imposed currents were present. The strong shear on the local upstream side of the ripples and the subsequent vortex developed on the downstream side were visible. Sediment was evident in the fluid above the bed to a height equal to about half the wavelength of the ripples. (Cassar-FRC)
W82-06527

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,
CH2M Hill, Bellevue, WA.
J. L. Scott.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 101-116, 1982. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Sediment transport, *Deltas, *Intertidal areas, Shores, Nisqually River, *Washington, Puget Sound, Beaches, Wave action, Sandpits, Particle size distribution, Water currents, Sediment distribution.

Sediment transport was studied along the east shoreline of the Nisqually River Delta, Puget Sound, Washington, to provide baseline data and to determine the possible effects of shoreline construction proposed by a timber company. Sediment transport on the beach was determined by interpretation by beach profiles and sediment texture and by a beach grain tagging experiment. Sediment movement on the delta platform was estimated from sediment trap data and an historical chart comparison. Several conclusions were reached from the studies. Waves are responsible for the small amount of sediment transported on the beach, and tidal currents cause sediment transport over the delta platform. The small amount of sediment transported in the intertidal zone occurs in a northerly direction, reflecting the predominance of southerly winds. The intertidal sediment consists of poorly sorted sandy gravels; the delta sediments, moderately sorted silty sands. On the delta platform sediment transport rates are 0.00004 g per cm-sec or less, with local increases due to bioperturbation. Tidal currents determine the direction of transport. The sediment grain size data indicate a depositional or no-transport environment along the eastern shore of Nisqually Reach, a U-shaped trough offshore from the delta. A man-made sandspit perpendicular to the shore, located between the proposed timber company wharf and the delta, is being gradually eroded. It has negligible effects on sediment transport in the delta platform and intertidal zones. The present wharf, north of the delta, attenuates wave energy from the north. An enlarged, improved wharf should be designed to allow nonrestricted movement of sediments and currents. (Cassar-FRC)
W82-06553

EROSION AND SEDIMENT,
Soil Conservation Service, Lanham, MD.
W. F. Mildner.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 161-166, 2 Fig, 9 Ref.

Descriptors: *Erosion, *Sedimentation, Sediment yield, Slopes, Rainfall, Vegetation effects, Sediment delivery ratio, Universal Soil Loss Equation, Suspended load, Suspended sediments, Particle size, Watersheds, Sheet erosion, Soil erosion, Reviews.

Methods of measuring erosion and sediment are described. The most commonly accepted equation for determining soil loss is the Universal Soil Loss Equation, which predicts the average annual soil loss (sheet plus rill erosion) in tons per acre. The six factors comprising the equation (rainfall, soil erodibility, slope length, slope gradient, cropping management, and erosion control practice) are discussed. Sediment yields may be determined from gross erosion and sediment delivery ratios by measuring sediment accumulation, by sampling suspended sediment loads, or by using predictive equations expressing sediment yield as a function of measurable independent variables. Sediment delivery ratios are essential to the sediment yield equation mentioned above. Factors influencing the sediment delivery ratio are types of sediment sources (channel or sheet), magnitude and proximity of sediment sources, transport system, (clogged or open channels, meandering or straight, etc.) size of eroded material (small particles are more easily transported), areas of deposition (foot of slopes, in valley flats, at the heads of lakes, etc), and watershed characteristics (high relief produces high sediment delivery ratios). One procedure for estimating sediment delivery ratio requires statistical analysis of available data where the sediment delivery ratio is a dependent variable and measureable watershed factors are the independent variables. Previous workers have also related the sediment delivery ratio to the size of drainage area, relief-length ratio, and sources of deposition. (Cassar-FRC)
W82-06554

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
A. M. Anikeenko, O. N. Litvin, and I. A. Sherenkov.
Water Resources, Vol 8, No 3, p 263-266, May/June, 1981. 2 Fig, 6 Ref. Translated from Vodnye Resursy, No 3, p 80-84, May/June, 1981.

Descriptors: *Finite element method, *Turbulent flow, *Sediment transport, Suspended solids, Suspended sediment, Settling basins, Eddy diffusion, Settling velocity, Numerical analysis, Model studies, Hydrodynamics, Mathematical models.

Transport of suspended matter in turbulent flows is examined for the separate class of problems in which small-sized, small volume concentration particles predominate (examples: suspended sediment transport, settling basins, recycled water ponds). In these cases suspended matter transport may be described by a boundary value problem for the turbulent difference diffusion equation. Where the widths of flow are small compared to the lengths (canals, horizontal settling basins, long water bodies) two-dimensional solutions can be used. Several problems are solved by the finite element method using the Ritz procedure and the concept of local potential. (Cassar-FRC)
W82-06620

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,
Oklahoma Univ., Norman. Dept. of Zoology.
B. L. Kimmel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256843, Price codes: A06 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute Report, April 1981, Stillwater. 95 p, 27 Fig, 6 Tab, 107 Ref. OWRT A-088-OKLA(2), 14-34-0001-0138.

Descriptors: *Surface runoff, *Euphotic zone, *Influent seepage, *Photosynthetic bacteria, *Suspended solids, *Reservoir stages, Watershed management, Reservoirs, Phytoplankton, Photosynthesis, Nutrient requirements, Suspended load, Field tests, Bacteria, Organic matter, Aquatic plants, Essential nutrients, Suspended sediments, Runoff.

Laboratory studies with experimental water columns and field studies in a lake were undertaken to examine the effects of introduced nutrients and suspended soil particles (SSP) on organic matter production in man-made impoundments. Watershed runoff experiments and in place monitoring of inflow events in the lake showed that turbidity associated with river-borne (SSP reduced the euphotic layer thickness, inducing light-limited phytoplankton (PP) photosynthesis in a larger portion of the water column. Nutrient desorption from SSP enhanced nutrient availability for PP and bacterioplankton (BP) production, and was dependent on soil nutrient composition. Increased nutrient availability associated with watershed inflow stimulated PP production in the water column euphotic layer. The presence of SSP did not significantly stimulate microheterotrophy. Highly turbid watershed runoff caused vertical displacement of PP cells in laboratory water columns and during runoff events in the lake. These results indicate ultra-PP and free-living bacteria are coflocculated in high SSP concentrations. In both laboratory and field studies, the PP-BP response to turbid inflow occurred in 3 district phases: light limitations of photosynthesis; partial removal of PP and bacteria from the water column by combined advective-vertical displacement; and nutrient stimulation of euphotic layer PP. An analogous sequence should occur in reservoirs having similar inflow characteristics. (Zielinski-MAXIMA)
W82-06710

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 855-862, June, 1982. 122 Ref.

Descriptors: *Literature reviews, *Sediments, *Fate of pollutants, *Metals, *Reviews, Sedimentation, Sediment transport, Sampling, Chemical analysis, Heavy metals, Nutrients, Organic compounds, Benthic fauna, Invertebrates, Model studies, Phos-

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phorus, Nitrogen, Lake sediments, Reservoirs, Bacteria.

A review of recent papers on aquatic sediments includes analytical and sampling methods, heavy metals, nutrients, biological activity, organic pollutants, and modeling and sediment transport. Analytical methods described the use of neutron activation for trace metal analysis, a method for Be7 direct measurement, methods for simultaneous determination of 15 and 20 metals, and procedures for detection of Zn, Cd, Ca, Pb, Fe, Al, Hg, Ba, and Ra. Chromatography and/or mass spectrometry techniques were applied to determination of organic compounds. Sediment core sampling and sediment traps were the subject of several papers. Heavy metals investigations showed that suspended solids levels under estuarine conditions did not remove dissolved chromate from the water column. In a wastewater effluent receiving stream Mn remained dissolved, and other heavy metals were associated with the colloidal and particulate fraction. In uranium mine effluent Ba(Ra)S04 was a predominant particulate phase. Relationships between nutrients, especially P, and sediments were discussed. Release of nutrients from sediments was related to oxygen status, redoxpotential, and mineral phases. Investigations of biological activity in sediments included oxygen demand, activity of nitrifying organisms in different layers of a lake, metabolism of sediment bacteria under anaerobic conditions, bacterial degradation of organic pollutants in sediments, and effects of pollutants on benthic fauna. Case studies of organic pollution incidents and models for transport or organic compounds were discribed. Several sediment transport models concerned agricultural runoff, sediment yield from forested watersheds and streams, sediment behavior in reservoirs and lakes, and sediment-water exchange models. (Cassar-FRC)
W82-06806

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06858

CALCULATION OF CUMULATIVE PERCENTAGE AT SELECTED PARTICLE SIZES FROM BOTTOM WITHDRAWAL TUBE ANALYSIS,
Department of the Environment, Ottawa (Ontario). Computing and Applied Statistics Directorate.
C. S. Lam.
Water Resources Bulletin, Vol 18, No 3, p 525-528, June, 1982. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Particle size, *Suspended sediments, Computers, Sediments, *Oden curve, Mathematical studies, Statistical studies, *Sedimentation.

A new method is proposed for obtaining a single continuous Oden curve in a sediment particle size analysis. A time scale transformation is introduced, and the cumulative percentage of a selected particle size is analytically determined by cubic spline coefficients in the tangent intercept on the curve. Of the 124 tested samples, 113 samples could be fitted by a four-knot pline function. Six of the failed 11 samples could be fitted by a five-knot spline function. Three of the remaining 5 samples could be fitted by a five-knot spline function after deletion of one bad data point. Only two samples failed all attempts. The economy of this new approach over the manual graphical method is obvious. A more significant point is that the percent finer of a selected particle size is determined through a single continuous curve. The accuracy of the result obtained by averaging two approximated tangents of two overlapping segments, in which the continuity of the Oden curve is in question in the graphical method, is no longer an argument in the new approach. On a CYBER 74 computer, it took 14.15 seconds to calculate the equivalent percentages in a 100 cm high suspension of sediment and corresponding settling times for 124 samples from laboratory measured data. The calculation of percent finer at 15 selected particle sizes for all samples took 20.25 seconds. (Bakr-FRC)
W82-06873

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W82-06876

FIRE AND GEOMORPHIC PROCESSES,
F. J. Swanson.
In: Proceedings of the Conference on Fire Regimes and Ecosystem Properties, December 11-15, 1978, Honolulu, Hawaii, General Technical Report WO-26, Forest Service, Washington, D.C., June 1981, p 401-420, 4 Fig, 81 Ref.

Descriptors: *Fires, *Geomorphology, *Soil erosion, *Sediment yield, *Hydrology, *Vegetation, Sediment transport, Forest fires, Soil water, Overland flow, Sediment erosion, Accelerated erosion, Watershed management.

Fire alters vegetation and soil properties; these changes alter the hydrologic regime of a site with the collective effect of changing the movement of soil and sediment through watersheds. Interactions among fire, hydrology, and geomorphology vary with the time scale on which a landscape ecosystem is considered. On the short time frame of immediate effects of a single fire on hydrology and geomorphology, fire operates principally through alteration of vegetation and soil properties to alter hydrologic and geomorphic processes. The effects are generally increased soil water and overland flow which result in accelerated erosion by a variety of surface and mass movement processes. The contribution of fire-induced accelerated erosion to overall sediment yield can be assessed on the intermediate time scale of several fire rotations. Highly erosive landscapes with frequent, intense fire may have more than 70% of their long-term sediment yield exported during the period of accelerated erosion immediately following a fire. The magnitude of geomorphic effects of fire in an ecosystem depends on the frequency and intensity of fire, and the sensitivity of geomorphic systems to disturbance. Geomorphic sensitivity is controlled by hillslope and channel steepness and the effectiveness of vegetation in regulating physical processes. A variety of hydrologic and geomorphic features function as firebreaks. (Moore-SRC)
W82-06963

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,
Humboldt State Univ., Arcata, CA., Dept. of Geology.
For primary bibliographic entry see Field 4D.
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 4D.
W82-06971

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 8B.
W82-06990

2K. Chemical Processes

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W82-05990

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,
Central Electricity Research Labs., Leatherhead (England).
A. H. Webb.
Water Research, Vol 16, No 5, p 641-648, May, 1982. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Seasonal variation, *Chemical composition, *Acids, Tovdal River, *Norway, Physicochemical properties, Acid rain, Nitrates, Sulfates, Chlorides, Aluminum, Silica, Snowmelt, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium, Ammonium, Water analysis, Leaching, Organic carbon.

Chemistry of water in the Tovdal River, Norway, was investigated by analysis of weekly samples from August 1978 to December 1979. The pH varied slightly over the study period, 4.64 to 5.14, and was lowest in winter. Concentrations of both the air pollution derived species (sulfates, nitrates, and ammonium) and groundwater derived minerals (Ca, Mg, and K) increased steadily in river water during summer and winter to a broad peak during spring and decreased to a minimum in summer. The rapid metabolism of nitrate and ammonium produced some irregularities in their patterns. The broad peak in spring of the acid rain constituents (sulfates and nitrates) coincided with the peak in alkalis because of leaching from the ground during the snowmelt period. Sulfate levels were higher in the fall of 1979 than in the fall of 1978, alkalis were lower, and therefore pH was lower. Total weak acid concentrations (silica, Al, and ammonium) also showed spring maximums and summer minimums. These were correlated with total organic carbon concentrations, but the inorganic weak acid species largely controlled the seasonal variations in weak acid content. (Cassar-FRC)
W82-06052

A FAUNAL ANALYSIS OF THE SPRINGS OFF THE OUACHITA MOUNTAINS, ARKANSAS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
H. W. Robison.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254871, Price codes: A03 in paper copy, A01 in microfiche. Publication No 83, September 1981. 33 p, 1 Fig, 3 Tab, 39 Ref. OWRT A-047-ARK(1). 14-34-0001-9004.

Descriptors: Benthic Fauna, *Aquatic animals, *Springs, *Microinvertebrates, Surveys, Fauna, Aquatic life, Aquatic habitats, Aquatic populations, Aquatic soils, Aquatic environment, Ecosystems Isopods, Crustaceans, Amphipods, Caddisflies, Aquatic insects, Calcium Carbonate, *Arkansas, Ouachita Mountains, Pollutant identification.

A faunal survey was made of 33 spring ecosystems in a 135 by 80 km study area in the Arkansas Ouachita Mountains physiographic province, extending west from Hot Springs to the Oklahoma line. Springs in this province were characterized as being generally faunistically-poor, with often only a single species (e.g., the isopod, Lirceus H. hoppinae) being the dominant faunal element with respect to both numbers and biomass. A total of 40 invertebrate species and eight vertebrate species were collected from the spring environs during the course of the study; five additional invertebrate species (two amphipods, three caddisflies) were discovered from a detailed literature search, making a total finding of 53 aquatic invertebrate and vertebrate species that characterize the springs in this mountain physiographic province. Water quality of the springs is characterized as potable, with calcium (calcium bicarbonate) as the major element due to the widespread distribution of limestone and calcaeous cements throughout the area of study. An annotated list of the 45 benthic macroinvertebrates and eight vertebrates collected in this survey is provided. (Zielinski-MAXIMA)
W82-06161

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W82-06179

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
D. H. Loring.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 930-944, May, 1982. 3 Fig, 7 Tab, 28 Ref.

Descriptors: *Sediments, *Heavy metals, *Path of pollutants, *Bay of Fundy, Zinc, Copper, Lead, Cobalt, Nickel, Chromium, Vanadium, Mercury, Beryllium, Arsenic, Barium, Selenium, Bays, *Canada.

This study reports on the sedimentological, mineralogical, chemical and anthropogenic factors that control the sedimentary abundances and gradients of zinc, copper, lead, chromium, vanadium, cobalt, nickel, mercury, beryllium, arsenic, barium and selenium as well as an estimation of the potential bioavailability of zinc, copper, lead, cobalt, nickel, chromium, and vanadium in the fundy sediments. Sediment samples were collected at 100 locations, Total Zn, Cu, Pb, Co, Ni, Cr, V, Be, Hg, As, Se, and Ba concentrations varied regionally and with textural differences in the sediments. Except for local anomalies, the concentrations are at or near natural levels when compared with texturally equivalent sediments from unpolluted areas of the eastern Canadian coastal areas. The nature, grain size, and abundance of the metal-bearing minerals, amorphous compounds, and organic matter are the main factors controlling the metal gradients in the bay of Fundy. Of the total metal content, 73-99% is not readily available to the biota but is held in various sulfide, oxide and silicate minerals. The host minerals have accumulated at the same rates as other detrital material, except for particles of zinc oxide that have been derived from industrial sources adjacent to the bay. Relatively high metal concentrations did occur near a dredge dispersal site off St. John Harbor and may reflect the initial impact of anthropogenic inputs on the natural levels of metals in the Fundy sediments. (Baker-FRC)
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W82-06190

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 5B.
W82-06245

THE POTENTIAL ACIDITY ASSOCIATED WITH DEWS, FROSTS, AND FOGS,
Flow General Inc., McLean, VA.
J. Wisniewski.
Water, Air, and Soil Pollution, Vol 17, No 4, p 361-377, 1982. 3 Fig, 1 Tab, 51 Ref.

Descriptors: *Acidity, *Condensation, *Frost, Chemical composition, *Fog, *Dew, *Pollutant identification, Precipitation, Chemical analysis, Corrosion, Vegetation effects.

In general special events of dews, frosts, and fogs are the result of water vapor condensation or sublimation in the layers of the atmosphere closest to the ground. The meteorology of these special events is briefly reviewed, including mechanisms of their formation as well as their frequency of occurrence. While research into the chemistry of the water involved in these special events is sparse, there is direct and indirect evidence available which indicates a potential acidity. The chemistry of this water is primarily dependent on two factors. The first is the amount and type of material absorbed by dew and fog directly from the atmosphere. The second controlling factor is the presence of substances, on the surface of which the moisture is deposited. The source of most of these materials is dry deposition of natural and anthropogenic substances from the atmosphere, including soil particles, fly ash, pollen, microbes, trace metals, aerosols, and adsorbed gases. Values of pH associated with these events have been observed to be below 3.0 for fog. Theoretical calculations indicate that synergistic acidity from dew combined with previous acidic dry deposition may result in pH values of less than 2.0. Neutralization due to leaching of plant metabolites or surface reactions on contact could raise the pH, but either of these two processes would damage the plant or material surface in question. (Baker-FRC)
W82-06246

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,
Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts.
Water Research, Vl 16, No 7, p 1273-1276, July, 1982. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water analysis, *Spectrophotometry, Metals, Iron, Aluminum, Manganese, *Humic acids, *Tannic acids, *Lignosulfonic acids, Organic compounds, Chemical analysis, Chemical reactions, Natural waters, *Metal ions.

A study was conducted to assess the consequences of metal-organic interactions on the quantification of fulvic acid, tannin and lignin in natural waters. Solutions were prepared so that the final concentrations of humic acid, tannic acid and lignosulfonic acid were each 5.00 ppm. Ferric iron was added to individual solutions to final concentrations of 0.0, 0.1, 0.5, 1.0, and 5.0 ppm. Changes in the ultraviolet spectra of the three acids as a function of increasing iron concentration wre demonstrable. In all cases the highest iron concentration showed the dominance of the iron spectrum. At lower iron concentrations it was apparent that the spectral alterations occurring for humic acid and lignosulfonic acid were different from those for tannic acids. While the spectra of both humic acid and lignosulfonic acid in the presence of ferric iron appear to be additive with that of the metal, the spectral changes of the tannic acid in the presence of ferric iron show a dimunution of the peak height at 280 nm with the attendant appearance and increase of a shoulder in the spectra at 320-340 nm. These changes indicate alteration of the electron configuration due to interaction with the iron either through complexation or due to steric considerations. These findings suggest that the concentrations of metals in natural waters are important when attempting to determine the concentrations of humic or fulvic acids, tannins and lignin in natural waters using a method based on ultraviolet spectrophotometry. (Baker-FRC)
W82-06273

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,
Foras Forbartha, Dublin (Ireland).
For primary bibliographic entry see Field 5A.
W82-06314

TRACE METAL RELATIONSHIPS AT THE SEDIMENT-WATER INTERFACE,
Vermont Univ., Burlington. Dept. of Geology.
J. C. Drake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256561, Price codes: A05 in paper copy, A01 in microfiche. Report, December, 1980. 77 p, 5 Fig, 1 Tab, 75 Ref, 1 Append. OWRT A-039-VT(1).

Descriptors: *Trace metals, *Sediment-water interfaces, *Chemical analysis, *Chemical stratification, *Sediments, Interstitial water, Phosphorus, Copper, Lead, Water quality control, Water quality, Organic matter, Trace elements, Trace levels, Toxicity, Metals, Chemical properties, Water analysis, Chemical composition, Mud-water interfaces, Cores, Bays.

Interstitial waters from nine cores of near-surface sediments from four bodies of water were analyzed for trace elements (reactive phosphorus, (P), iron, manganese, copper (Cu), lead (Pb), titration alkalinity, wet sediment porosity and redox potential, to assess the capability for chemical exchange at the sediment-water interface. Only Pb and Cu did not show significant enrichment in pore waters relative to overlying lake waters. Iron generally increased with depth; P often showed more than one peak concentration with depth. The data indicated that pore water chemistry differed significantly among samples from various sites, caused by organic matter decomposition. Diffusion of Cu and Pb out of the sediments is not considered significant, but bottom sediments constitute an enormous reservoir of chemically mobile iron, manganese and P which could potentially be released into overlying lake waters (especially when surface sediments become anoxic). St. Albans Bay P chemistry should be studied further, due to the extremely high concentrations of P in interstitial waters and the very low redox potential observed for St. Albans Bay surface sediments. (Zielinski-MAXIMA)
W82-06362

OCCURRENCE OF FLUORIDE BEARING GROUNDWATERS AND THEIR RELATIONSHIP WITH WATER TABLE FLUCTUATIONS,
Andhra Univ., Waltair (India).
V. V. J. Sarma, and A. N. Swamy.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 77-81, February, 1981. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Fluorides, *Groundwater, *Water table fluctuations, Water quality,Chemical composition, Apatite, Seasonal variation, Wells, Shallow wells, Visakhapatnam Basin, India, *Pollutant identification.

A 12-month study of fluoride levels in 130 shallow wells up to 60 ft deep in the Visakhapatnam Basin India, showed that the fluoride content of the water was maximal during the season of minimum water table in February-May and minimal during October when the water table was highest. For example, water in Well 43 varied from 5.0 to 8.0 ppm fluoride and water in Well 23 varied from 0.6 to 1.8 ppm fluoride. The designation of isofluores, lines of equal fluoride content, clearly located possible areas of fluoride bearing minerals, probably apatite. (Cassar-FRC)
W82-06443

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
E. Michnowsky, L. M. Churchland, P. A. Thomson, and P. H. Whitfield.
Water Resources Bulletin, Vol 18, No 1, p 129-132, February, 1982. 1 Fig, 12 Ref.

Descriptors: *Measurement techniques, *Metals, Water analysis, *Sample preservation, Water sampling, Suspended sediments, Trace metals, *British Columbia, Fraser River.

Although acidification is a common method used for the preservation of river and estuarine water samples collected for metal analysis, the effect of such treatment when high levels of suspended sedi-

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ments are present has not been evaluated. Water samples with high concentrations of suspended sediments were collected from the Fraser River in British Columbia, Canada. These samples were acidified on site, taken to the laboratory, and analyzed for concentrations of extractable copper, zinc, lead, cobalt, cadmium, manganese, nicke, and iron at various intervals of over a 6 month period. The metal concentrations in these water samples were found to be unstable, with the concentrations of extractable metals generally increasing during storage. The largest increases in concentration typically occurred between 10 and 40 days. Many of these metals maintained a constant concentration during the first week of storage and/or after 100 days. These results indicate that the extractable metal technique is not suitable for analysis of water samples containing suspended sediments, since it is not restrictive enough to ensure reproducible results. Comparisons between samples stored for varying periods of time would also not be reliable. (Carroll-FRC)
W82-06630

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,
Plymouth Polytechnic (England). Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W82-06668

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,
State Univ. of New York, Syracuse. Dept. of Civil Engineering.
C. T. Driscoll, and G. E. Likens.
Tellus, Vol 34, No 3, p 283-292, June, 1982. 4 Fig, 37 Ref.

Descriptors: *Hydrogen ion concentration, *Forests, Ecosystems, Aluminum, Nitric acid, Sulfuric acid, Acidity, Precipitation, Water quality, *New Hampshire, Forest watersheds.

A detailed evaluation was made of the hydrogen ion budget for the Hubbard Brook Experimental Forest in West Thornton, New Hampshire. Hydrogen ion sources were found to approximately balance hydrogen ion sinks. Atmospheric hydrogen ion inputs contributed 52% of the total hydrogen ion sources for the ecosystem. Based on this budget, projections of changes in precipitation hydrogen ion loading on water quality were made. To make such prediction it was necessary to make some assumptions concerning the response of a forested ecosystem to increases and decreases in atmospheric hydrogen ion inputs. To estimate changes in water quality due to changes in hydrogen ion loading, a modified chemical equilibrium model was used. The model was incrementally titrated with strong acid or strong base corresponding to the incremental change in hydrogen ion loading. Three changes in precipitation loading of hydrogen ion to the ecosystem were examined. These changes were made as nitric acid, as sulfuric acid, and as a combination of nitric and sulfuric acids, corresponding to the ambient stoichiometry in precipitation. The magnitude of these hydrogen ion loading changes ranged from a 50% increase to the lowest possible decrease based on the concentration of nitrate and sulfate in ambient precipitation. The form of the acid input is important in the response of stream water quality to changes in hydrogen ion inputs. Another important consideration is the role of aluminum in the buffering of hydrogen ion in this ecosystem. (Baker-FRC)
W82-06836

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2D.
W82-06850

STABILITY OF BETA-MNOOH AND MANGANESE OXIDE DEPOSITION FROM SPRINGWATER,
Geological Survey, Menlo Park, CA.
J. D. Hem, C. E. Roberson, and R. B. Fournier.
Water Resources Reseearch, Vol 18, No 3, p 563-570, June, 1982. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Natural waters, *Manganese oxides, *Chemistry of precipitation, Chemical reactions, Spring water, Springs, Chemical composition, Thermodynamics, *Oxidation-reduction potential.

Beta-MnOOH is precipitated preferentially at temperatures near zero degrees C when Mn(2+) is oxidized in aerated aqueous solutions. On aging in solutions open to the atmosphere a slurry of beta-MnOOH tends to disproportionate to form manganese dioxide and MN(2+). In such aged solutions, Mn(2+) and H(+) activities can be constant and both the oxidation reaction and the disproportionation reaction can have positive reaction affinities. It is not possible for both reactions to be in thermodynamic equilibrium in the same system unless oxygen is almost completely absent. Analytical data for manganese-depositing springwater samples are consistent with a nonequilibrium model involving disproportionation of either beta-MnOOH or Mn304. (Baker-FRC)
W82-06862

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,
Florida University, Gainesville School of Forest Resources and Conservation.
For primary bibliographic entry see Field 5C.
W82-06901

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,
Alaska Univ., Fairbanks, Inst. of Marine Science.
For primary bibliographic entry see Field 5A.
W82-06931

2L. Estuaries

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-05984

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06050

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-81/55, March 1982, Wahington, DC. 81 p, 29 Fig, 14 Tab, 154 Ref.

Descriptors: *Salt marshes, *Ecology, *Tidal marshes, *Environmental effects, Marsh management, Sediments, Tidal effects, Sea level, Vegetation, Productivity, Land use, Flooding, Drainage, Mosquitos, Pollutants, Sludge.

The high salt marshes of New England have evolved in response to sea-level rises through accretion of sediments entrapped by marsh vegetation. The shape and appearance of high marshes result from unique, complex interactions of local topography and bathymetry, sea level rise, tides, sediment supply and vegetation. These factors particularly the major influences of tides and short-term changes in sea-level, are incorporated in short-term processes that define and mold the ecology of the high marsh. Short-term and long-term mechanisms have produced approximate zonation of vegetation in the high marsh. High marshes are contrasted to Spartina-dominated low marsh in terms of plant and animal species and the relative importance of the dynamics of production, export, decomposition, and accumulation of materials in the sediments. Since the mid 1600's, the marshes in New England have been flooded or drained, impounded or diked, ditched or filled. High marshes have been used as hay fields. Ditching for mosquito control has affected a large part of the New England high marshes. Human activities have polluted the marshes with metals, oil chemicals, and trash. Habitat management considerations today include mosquito control and sewage sludge treatment. (Moore-SRC)
W82-06096

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center.
For primary bibliographic entry see Field 2J.
W82-06189

RETENTION OF RIVERINE IRON IN ESTUARIES,
Maine University at Orono, Walpole.
For primary bibliographic entry see Field 5B.
W82-06191

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 5B.
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 203, January, 1980. Council for Scientific and Industrial Research, Pretoria, South Africa. 122 p, 15 Fig, 57 Tab, 17 Ref, 3 Append.

Descriptors: *Trace metals, *Chemical analysis, *Water analysis, *Pollutant identification, *Water pollution sources, Trace elements, Trace levels, Lagoons, Estuaries, South Africa, Water quality, Environmental quality, Sediment-water interfaces, Heavy metals, Pollutants, Rivers, Nonpoint pollution sources, Sediments, Cores, Metals, Water quality control, Surveys, Atomic absorption spectroscopy.

Detailed surveys undertaken during 1975-78 to study the trace metal content of the Knysna River and Lagoon are summarized. Surface sediment, water, and sediment core samples were taken over an 11.5 sea mile distance, and analyzed by atomic absorption spectroscopy for 16, 13, and 16 elements, respectively. Interelement relationships and absolute metal concentrations were examined prior to data interpretation. Water salinity was also measured at certain sites, and biological material was taken from the Heads region and analyzed for 9 elements. The results indicated the presence of specific sites of metal input into the Lagoon and the distribution of drains/seepages which also contaminate the area. The metal concentrations found, however, were generally low, and such anomalies as do occur appear to be transitory in nature since little metal accumulation was found to occur in the sediment column. The area cannot be strictly considered as polluted, although certain metal concen-

trations were elevated above true background values as determined for other southeastern Cape estuaries. Metal concentrations in biological material from Knysna estuary were much lower than many of the reported values for the material species, indicating that the estuary is unpolluted by zinc, cadmium, copper, iron, manganese, and nickel. (Zielinski-MAXIMA)
W82-06388

STATISTICAL SEARCH FOR HIGH WATER AT BOARD LANDING BRIDGE, TRURO, NOVA SCOTIA,
G. Godin, P. A. Bolduc, D. G. Mitchell, and S. Yuen.
Marine Sciences and Information Directorate, Manuscript Report Series No 58, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 43 p, 7 Fig, 7 Tab, 7 Ref, 1 Append.

Descriptors: *Prediction, *Mathematical studies, *Tides, *Correlation analysis, *High water mark, *Bridges, Statistical methods, Probability distribution, Tidal waves, Tidal amplitude, Tidal currents, Forecasting, Water level fluctuations, Model studies, Regression analysis, Computer programs.

In order to obtain an estimate of the height of the high water at a Nova Scotia bridge, a statistical search was made of the two-year data of tidal observations at the bridge. Strong shallow-water distortion in the area precluded the use of a direct harmonic analysis; therefore, correlations were calculated between the time of travel of high water to the bridge and its height there against the high water height of nearby reference stations. The random portion of the signal was evaluated following a regression analysis with Saint John and other stations. The predicted height of high water at Saint John gave the best fit, suggesting a coupling between non-tidal events at the two sites. A height of 33.3 feet with a return period of about 90 years was inferred from the results. In order to check on the recurrence interval of extreme tides in the Bay of Fundy, 100 years of predictions covering the interval of 1981-2080 for Saint John were prepared. Further, it is felt that studies on the dynamics of Minas Basin will eventually have to be undertaken; to a good first approximation, the Basin may be viewed as being cut off from the Bay of Fundy as far as disturbances are concerned. (Zielinski-MAXIMA)
W82-06394

MINERALIZATION OF DETRITAL LIGNOCELLULOSES BY SALT MARSH SEDIMENT MICROFLORA,
Georgia Univ., Athens. Dept. of Microbiology.
A. E. Maccubbin, and R. E. Hodson.
Applied and Environmental Microbiology, Vol 40, No 4, p 735-740, October, 1980. 2 Fig, 2 Tab, 28 Ref. OWRT A-082-GA. 14-34-0001-9011.

Descriptors: *Pine trees, *Salt marshes, *Microorganisms, Carbon cycle, Mineralization, *Degradation, Carbon, Detritus, *Lignocelluloses.

The rates of degradation of specifically radiolabeled, extractive-free lignocelluloses from S. alterniflora and Pinus elliotii were determined in incubations approximating conditions in the aerobic surface layers of various marsh and estuarine habitats. The pine lignocellulose was included as it is a lignocellulose of terrestrial origin that is likely to be transported into the estuarine environment by stream runoff. A 10- to 14-fold difference was found in the rates of mineralization of the lignin moieties of lignocelluloses from S. alterniflora and P. eliottii, which was probably indicative of basic structural differences between the lignins of grasses and gymnosperms. Data collected confirmed the widely held assumption that lignocellulose accounts for a large percentage of the standing stock of plant material in salt marsh estuaries. Knowledge of thee factors controlling rates of lignin and cellulose degradation in marsh and coastal sediments can enhance the understanding of carbon flow in detritus-based systems. This will have wide applicability in studies of microbial processes in marsh-dominated coastal marine environments. (Small-FRC)
W82-06410

VEGETATION STRUCTURE AND DIVERSITY COMPONENTS OF A FRASER ESTUARY TIDAL MARSH,
British Columbia Univ., Vancouver. Dept. of Botany.
G. E. Bradfield, and G. L. Porter.
Canadian Journal of Botany, Vol 60, No 4, p 440-451, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Estuaries, Vegetation, *Tidal marshes, *Species diversity, *Marsh plants, Tidal rivers, Species composition, Tidal floods, Drainage effects, Community development, *Fraser River estuary, *British Columbia.

Vegetation data from a predominantly freshwater-influenced tidal marsh near the mouth of the Fraser River in southwestern British Columbia were analyzed to examine compsitional variation in the vegetation in relation to inferred gradients of tidal flooding and drainage. Another goal of the study was to evaluate various diversity components of marsh vegetation types and assess their value for heuristic investigation of vegetation-environment relations in tidal marsh ecosystems. Three main vegetation zones were recognized. Regularly flooded and drained sedge areas were dominated by Carex lyngbyei. A grass-willow zone along the crests of infrequently flooded levees was dominated by Festuca arundinacea. A mixed-forb zone in areas of poor drainage where the water table remained permanently high was dominated by Menyanthes trifoliata. Principal components analysis and reciprocal averaging gave similar results except for a 90 degree rotation of ordination axes. The combined results from cluster analysis and ordination provided a useful summary of the marsh vegetation structure and a useful background for making comparisons and evaluating factors that affect community development. (Geiger-FRC)
W82-06465

VEGETATION-ENVIRONMENT RELATIONS IN A BRACKISH MARSH, LULU ISLAND, RICHMOND, B.C.,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
I. Hutchinson.
Canadian Journal of Botany, Vol 60, No 4, p 452-462, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Marsh plants, *Succession, *Species diversity, *Estuaries, Brackish water, *Tidal marshes, *Salinity, Ecology, Species composition, Salt marshes, Tide lands, Interstitial water, Marine sediments, Fluvial sediments, Elevation, British Columbia.

The relationship between plant species distribution and the physical factors of submergence, pore water salinity, sediment texture, and substrate water content was examined in the foreshore marshes of Lulu Island in the Fraser River delta. Analysis of tidal records revealed three elevational zones - a low marsh dominated by two Scirpus species, a middle marsh dominated by Carex lyngbyei, Triglochin maritimum and S. maritimus, and a high marsh community with four dominant plant species. Results of an analysis of variance procedure showed that elevation and elevation-salinity interactions were the main factors controlling plant distribution. Substrate texture and moisture content were significantly associated with variations in species abundance. The Lulu Island marshes are similar in flora and ecology to estuarine and deltaic marshes of Oregon and Washington and are influenced by fluvial regimes which affect salinity and sediment characteristics. (Geiger-FRC)
W82-06497

VARIABILITY OF TEMPERATURE, SALINITY AND TIDALLY-AVERAGED DENSITY IN THE MIDDLE ESTUARY OF THE ST. LAWRENCE,
Bayfield Lab. for Marine Science and Surveys, Burlington (Ontario).
L. R. Muir.
Atmosphere-Ocean, Vol 19, No 4, p 320-336, 1981. 4 Fig, 4 Tab.

Descriptors: *Mixing, *Temperature, *Salinity, Tidal effects, Tidal energy, Estuaries, Water temperature, Density, *St. Lawrence Estuary, Statistical analysis, Ontario, *Path of pollutants.

Variations in temperature (T), salinity (S), and density of water in the Middle St. Lawrence Estuary between Riviere du Loup and St. Roch were complex. Surveys produced 15,000 T-S pairs distributed over 62 13-hour profiling stations. The T-S curves at each station were linear, but it was impossible to relate temperature and salinity over the whole Middle Estuary for a month or two. The lack of correlation could not be explained in terms of linear combinations of the parameters for location in the estuary, the upstream water properties, the phase of the spring-neap tides, and the tidal energies. The tidally-averaged density structure was separable into horizontal and vertical components. The vertical variation over the whole estuary was explained by any one of three functional forms, but the horizontal variation was not explicable by any linear combinations of the parameters previously mentioned. Plots of horizontal variations in temperature, salinity, or density are not meaningful unless data are collected synoptically and over a period longer than one tidal cycle. Although the mixing process in the estuary appeared conservative and linear at a given instant in space and time, it was non-linear over space and time. (Cassar-FRC)
W82-06533

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06534

SEASONAL VARIABILITY AND TRANSPORT OF SUSPENDED MICROFUNGI IN A SOUTHEASTERN SALT MARSH,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Science and Coastal Research.
T. H. Chrzanowski, L. H. Stevenson, and J. D. Spurrier.
Applied and Environmental Microbiology, Vol 43, No 2, p 392-396, February, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Salt marshes, *Fungi, *Seasonal variation, Microorganisms, Suspended load, Water currents, Estuaries, Bioindicators, *Path of pollutants, Water pollution sources.

Microfungi are potentially useful as indicators of water mass movements and resuspension in estuaries and salt marshes. As part of a continuing investigation of their usefulness for this purpose, tidally induced and seasonal variations of suspended microfungi concentrations were assessed and the presence of microfungi in water exiting from a salt marsh was studied. Samples were collected at three depths from three stations positioned at a transect in a large salt marsh creek in South Carolina. Samples were taken every 1.5 hours for 50 consecutive hours during neap tides and for 50 consecutive hours during the corresponding spring tides. Microfungi concentrations were found to be relatively consistent from season to season. Tidally induced variability was more dramatic, with microfungi concentrations fluctuating out of phase with the tidal rhythm during both neap and spring tides. Over 90% of the tidal cycles monitored showed a net movement of microfungi out of the marsh, indicating that the microfungi should be useful in tracing a water mass after it has exited a marsh. These study results suggest that seasonal variations in the concentrations of suspended microfungi should not limit their usefulness as water mass indicators in salt marsh environments. (Carroll-FRC)
W82-06536

SULFATE REDUCTION AND METHANOGENESIS IN THE SEDIMENT OF A SALTMARSH ON THE EAST COAST OF THE UNITED KINGDOM,

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Essex Univ., Colchester (England). Dept. of Biology.
E. Senior, E. B. Lindstrom, I. M. Banat, and D. B. Nedwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 987-996, May, 1982. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salt marshes, *Chemical reactions, *Sulfate reduction, Marshes, Tidal marshes, Acidity, Sulfates, *Methanogenesis, Sediments, *England, Estuaries, Coastal waters, Coastal marshes.

A program of regular field sampling was initiated in the Colne Point salt marsh, Essex, United Kingdom. The main objectives of the program were to determine whether any spatial or temporal separation(s) between sulfate reduction and methanogenesis were apparent which might explain their coexistence, to determine the annual magnitudes of each process, and to investigate some of the environmental variables which might significantly influence the processes. These two processes are the major terminal oxidation steps in the flow of carbon and electrons in anaerobic environments. The rate of sulfate reduction, methanogenesis, and methane loss were measured in salt marsh sediment at monthly intervals. In addition, dissolved methane and sulfate concentrtions together with pS(2-) and pH were determined. Methane formation from carbon dioxide, but not from acetate, was detected within the same horizon of sediment where sulfate reduction was most active. Sulfate reduction was about 3 orders of magnitude greater than annual methanogenesis. The two processes were not separated either spatially or temporally, but occurred within the same layer of sediment at the same time of the year. Their coexistence did not seem to be the result of sulfate-depleted microenvironments within which methanogenesis could occur, but the methanogenic bacteria persisted at very low rates of activity within the same environment as the sulfate reducers. The observed discrepancy between in situ methanogenesis and methane loss from the sediment surface was interpreted as a real phenomenon, possibly due to methanogenesis from substrates other than acetate or bicarbonate. (Baker-FRC)
W82-06541

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
G. P. Steven.
Advances In Water Resources, Vol 5, No 1, p 29-34, March, 1982. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Finite element method, *Interfaces, *Boundaries, Model studies, Fate of pollutants, Mixing, Stratification, Thermal pollution, Mathematical studies.

Restructuring of coefficient matrices of a finite element solution gave good results for problems in which physical parameters had discontinuities at the interfaces. In this work one-dimensional model studies were done using four schemes for accommodating a moving interface across which there are discontinuities in physical parameters. The effective schemes were: development of a special element which allowed the interface to move across it, and using an adaptive grid so the interface always remained at an element boundary. However, only the first was suitable for use in two- and three-dimensional problems. These solutions may be applied to problems such as salt-fresh water interaction in an estuary, stratification in water bodies, thermal outputs from power stations, sewage discharges, and injection of one fluid into another. (Cassar-FRC)
W82-06546

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,
Plymouth Polytechnic (England). Dept. of Marine Science.
G. E. Millward, and R. M. Moore.
Water Research, Vol 16, No 6, p 981-985, June, 1982. 4 Fig, 1 Tab, 34 Ref.

Descriptors: *Estuarine environment, *Trace metals, Estuaries, *Copper, *Manganese, *Zinc, *Iron, Model studies, *Adsorption, Acidity, Salinity, Chemical reactions.

The sorption of behavior of copper, manganese and zinc on to freshly precipitated iron oxyhydroxide was investigated as a function of acidity and salinity, in order to more fully understand the behavior of these metals in estuaries. In distilled water the acidity of the onset of adsorption was in increasing order from Cu, Zn to Mn, which qualitatively follows the hydrolysis of the metals in the bulk solution. The pH of the adsorption edges could not be quantitatively predicted from the hydrolysis data, and it is necessary to resort to the use of surface complexation constants for cation adsorption. The hypothesis of metal uptake involving coulombic interactions between the precipitate and the metal species in solution did not fit the observations, and it was concluded that a detailed knowledge of surface complexation reactions was needed, as is shown for copper. The adsorption isotherms for copper were independent of salinity while those for zinc and manganese showed an increase in the pH of the adsorption edge with increases in salinity. It was suggested that the major cations of calcium and magnesium were probably co-adsorbed, and competition from these species for adsorption sites increased with increasing salinity. These results will aid in the development of predictive models for the fate of trace metals injected into estuarine systems, where iron compounds may be freshly precipitated. (Baker-FRC)
W82-06668

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,
Univerity of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06742

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5C.
W82-06748

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,
Rostock Univ. (Germany, D.R.).
For primary bibliographic entry see Field 5C.
W82-06763

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,
Institute fuer Meeresforschung (Germany, D.R.).
For primary bibliographic entry see Field 5B.
W82-06766

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,
Virginia Inst. of Marine Science, Gloucester Point.
D. Hayward, C. S. Welch, and L. W. Haas.
Science, Vol 216, No 4553, p 1413-1414, June 25, 1982. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Destratification, *Estuaries, Estuarine environments, Coastal workers, Rivers, Bays, Chesapeake Bay, *York River, *Salinity, Saline water intrusion, Stratification, Seasonal variations, Tidal rivers, Tides, Tidewater, *Virginia.

Desratification in the York River was investigated. A conceptual model for the onset and disappearance of vertical homogeneity was developed from a examination of salinity data collected during intensive studies of two destratification events that were predicted on the basis of earlier work. The intrusion of relatively fresh water, which initiated the destratification process, is indicated by the sharp downward displacement of isohalines on 16 August 1978 and 26 August 1980. In each case this was followed by a progressive reduction of stratification in the water column. The introduction of fresher water into the river mouth caused a reversal of the longitudinal salinity gradient, producing a midriver salinity maximum. The assumption is made that the salinity changes at the station are caused in large part by the advection of water of differing salinity up and down the river by tidal currents. Depressions in the isohaline, indicating the presence of freshwater water, coincide with slack before ebb through 28 august, the data of greatest tidal heights. After that date the isohaline at 23 per mil showed a phase reversal. The depressions are coincident with slack before flood, indicating the reestablishment of the normal longitudinal salinity gradient. While tidal heights were increasing, there was a continuing source of fresher water. As tidal heights reached, more saline water was once again present in the river mouth. The Chesapeake Bay was the only reasonable source for the relatively fresh water. The tidally synchronized advection of the relatively freshwater into the river mouth during sufficiently strong spring tides occurs as a result of the relationship of the tidal current phases of the river and the bay. During neap or mean tidal cycles the tidal excursion is insufficient to introduce relatively fresh water into the river. (Baker-FRC)
W82-06787

A STEADY STATE MODEL FOR BUOYANT SURFACE PLUME HYDRODYNAMICS IN COASTAL WATERS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Tellus, Vol 34, No 3, p 293-306, June, 1982. 11 Fig, 14 Ref.

Descriptors: *Coastal waters, *Plumes, Model studies, Hydrology, Hydrodynamics, Flow characteristics, Fluid mechanics, Buoyancy, *Connecticut River, *Long Island Sound, *Steady flow.

The horizontally two-dimensional, steady flow problem posed by the discharge of a shallow layer of buoyant fluid from an outlet channel at a coast into an unbounded domain of ambient water having uniform alongshore motion has been modeled. An ambient current is a necessary conditions for a steady state, since in its absence time dependent spreading of the buoyant layer would continue indefinitely. Thus the problem includes the basic features of horizontal gravitational spreading, frontal boundaries, and an ambient current. In this model earth rotation was neglected. Frontal jump conditions developed in an earlier paper were applied to match the flow at the frontal boundary with the remainder of the plume. Numerical solutions for the entire flow are found by the method of characteristics, but much of the flow can be determined by simpler analytic computation. The computed flow fields show that a frontal boundary forms on the upstream or offshore side of the plume, where the oncoming ambient current contains the gravitational spreading of the buoyant water. No front forms on the corresponding downstream, inshore side. In the body of the plume the flow simultaneously expands and turns downstream toward alignment with the ambient current. Relatively little change in plume water speed occurs, but the pressure field required for turning the flow downstream results in deepening of the plume interface offshore near the front. This in turn concentrates the plume volume flux along its offshore side near the front. The maximum angle through which the flow may be turned initially is less than 66 degrees. Outlet channel angles greater than this produce plumes which are separated from the shoreline by ambient water. The model results explain many of the observed features of the Connecticut River plume in Long Island Sound. (Baker-FRC)
W82-06837

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,
Lancaster University (United Kingdom), Department of Biological Sciences.

For primary bibliographic entry see Field 5C.
W82-06944

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION DIRECTORY 1981.
Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-248709, Price codes: A12 in paper copy, A01 in microfiche., Desalination, Vol 37, No 1, 2, May 1981. 255 p. OWRT C-90414-T(No 0401)(1).

Descriptors: *Desalination, *Water treatment, *Information exchange, *Technology transfer, *International commissions, Desalination plants, Desalination wastes, Desalination apparatus, Pretreatment of water, Clarification, Information systems, Documentation, Technology, Organizations, Industrial plants, Water use.

A first edition of an international directory of participants involved in desalination and water purification is presented. This directory should serve as a central tool to enhance communications among members of the world-wide desalting community. Overviews of activities in desalination and water purification are provided by individuals, organizations, and companies listed in the directory. The directory, hence, provides a useful information network for technology transfer in the desalination and water purification areas. Directory entries are both by alphabetical and geographical listings. A separate alphabetical listing of individuals, their affiliations, and addresses, is also included. Owing to the limitations encountered in preparing an initial directory, the narrative entries reflect the nature and scope of the organizations providing information, but are not necessarily proportional to the size, importance, or level of excellence of the organizations. This first edition also will serve as a checklist so that companies, institutions, and individuals can check their entries on their own merit and in relation to each other. A second edition, under preparation and planned for release in 1-2 years, will also include interests and society memberships of individuals, and a subject index. (Zielinski-MAXIMA)
W82-05908

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,
Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 1A.
W82-05910

TWO-PHASE FLOW THERMOSIPHONING FOR EVAPORATOR APPLICATION,
Westinghouse Research Lab., Pittsburgh, PA.
T. E. Lippert, J. M. Cardito, and R. M. Chamberlin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243403, Price codes: A04 in paper copy, A01 in microfiche. Final Report, January 1974. 53 p, 10 Fig, 12 Tab, 5 Ref, 1 Append. OSW (No 2880)(1), 14-30-2880.

Descriptors: *Saline water, *Thermosiphoning, *Evaporators, *Desalination apparatus, Design criteria, flow profiles, Photography, Laminar flow, Theoretical analysis, Mechanical engineering, Siphons, Process control, Water treatment, *Flash evaporation, Performance evaluation, Desalination, Water use, Water treatment.

Operation of an 11-foot long, 6-inch diameter thermosiphon was assessed, covering the two-phase flow-regime, determination of thermosiphon performance with regard to various system operating and design parameters, and a comparison of the resultant data with an existing homogeneous flow theory. Data were obtained on tap water, tap water with surfactant, and tap water with sea-salt. The results of this assessment demonstrated that the thermosiphon performed in a stable manner over the range of operating conditions examined. The predominant flow regime was churn bubbly, and was found to be essentially independent of the operating test conditions. High-speed movies clearly showed the character of the chugging action of the flow: the flow did not reverse direction, but rather represented an acceleration-deceleration phenomenon with a surrling pattern superimposed. Despite this apparent complexity, the time-average character of the flow was consistent and repeatable, and the thermosiphon did not stall, nor did the set point conditions on the flow loop drift significantly during operation. The operating temperature range studied, over which stable thermosiphon operating was noted, would correspond generally to the high temperature stages of a multi-stage flash evaporator. (Zielinski-MAXIMA)
W82-05916

CONDENSATION OF BUTANE VAPOR IN A GRAVITY-DRAINED ICE BED,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. L. Von Berg, P. Harriott, H. F. Wiegandt, and D. B. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243411, Price codes: A05 in paper copy, A01 in microfiche. Report, August 1974. 83 p, 23 Fig, 6 Tab, 19 Ref, 2 Append. OSW (3072)(1).

Descriptors: *Desalination, *Desalination apparatus, *Ice-brine systems, *Heat transfer, Saline water, Seawater, Brine disposal, Brines, Free water, Ice-water interfaces, Melting, Ice thickness, Process control, Mechanical engineering, Water treatment, Theoretical analysis, *Condensation.

Direct condensation of n-butane in ice particle beds was investigated to assess the effect of driving force, bed depth, and ice particle size on operation of a melter-condenser (MC) as part of an overall freezing process for salt water desalination. Ice melting rate for 2-12 inch thick ice particle beds was studied in a 3 foot by 2 or 4 inch inside diameter plastic column, using 0.1-17 mm diameter ice particles. Studies with the MC indicated that: ice melting rate in shallow ice beds is proportional to the true driving force for driving forces up to at least 0.5 F; ice melting rate per ice volume in the MC decreases with increased bed depth and is a function of ice particle size; and that the rate due to axial vapor velocity through the bed is proportional to the vapor velocity to the 1/4 power. The most severe restriction on melting rate of deep ice beds is imposed by liquid and vapor flow limitations through the melting bed. Butane condensation in shallow beds occurs throughout the entire bed, but the topmost ice particles melt faster than those deeper in the bed. Experimentally-determined heat transfer coefficients (for total particle area at 10% melt) for 3 and 12 inch ice beds were about 2/3 and 1/3 of those predicted from theory. (Zielinski-MAXIMA)
W82-05917

OPERATING EXPERIENCES ON A REVERSE OSMOSIS PLANT WHICH CONVERTS SEA WATER INTO BOILER FEED WATER,
R. M. Quinn.
Industrial Water Engineering, Vol 19, No 1, p 20-33, January/February, 1982. 2 Tab.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Economic aspects, Water treatment, Sea water, Brackish water, Water quality, Membranes, Industrial water, *Boiler water.

Points of interest in the operation and design of the Planta Centro seawater plant installation are offered. The pretreatment system was designed to meet the variable conditions found in using an open sea intake and, in particular, an intake located in a channel, making it subject to the effects of land based contamination. One of the major concerns was the ability of the B-10 membrane in the reverse osmosis system to stand up to the rigorous conditions of seawater treatment. While operating costs appear high compared to conventional water treatment plants, they are comparable to those experienced in treatment of seawater by evaporation. Total power consumption in the primary and secondary system is quite low, due to the relatively low cost of power in Venezuela. Chemical costs are greater than had been anicipated due to the high cost of chemicals in Venezuela, an open sea intake requiring the use of in line coagulation, and the high frequency of cleanup required to maintain the membrane's operation, which overcomes problems with corrosion in the pumps. This final cause of high costs should be eliminated in the future. Overall this plant confirms that in actual operation seawater reverse osmosis systems are viable and effective tools for the production of potable water. Reverse osmosis systems when combined with brackish membranes and conventional ion exchange can produce any level of quality water required by industry, all the way from potable to the ultimate water required by highly sophisticated electronics plants. (Baker-FRC)
W82-05976

WORK POTENTIAL: AN OBJECTIVE BASIS FOR THE COMPARISON OF DESALINATION PROCESSES,
A. N. Rogers.
Industrial Water Engineering, Vol 19, No 1, p 10, 12-19, January/Februrary, 1982. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Desalination, *Energy, Energy loss, Energy equation, Water quality, Water reuse, Water treatment, Brackish water, Seawater.

This paper introduces factors which permit the energy consumptions of various desalination processes to be reduced to a common basis. It is demonstrated that under some conditions thermal distillation processes compare favorably with membrane and freezing processes and with vapor compression distillation from the standpoint of energy consumption. In such a comparison it is essential to consider not only the amount of energy consumed but also the thermodynamic level of the energy. Energy requirements are calculated as Work Potential, that is the electrical energy which the prime heat or power source could generate in a power plant and deliver to a power grid. These calculations indicate that for the desalination of sea water or other concentrated feeds, the thermal evaporative processes of multi-stage flash, vertical tube evaporator, or HTME compare favorably with other desalination techniques. For the desalination of water of low salinity such as brackish water or dilute aqueous wastes streams, thermal desalination requires a slightly greater Work Potential. When supplied with waste heat, however, the Work Potential requirments of thermal distillation are practically identical with those of the membrane processes. (Baker-FRC)
W82-05977

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,
Kyoto Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W82-06006

AN ION-EXCHANGE PROCESS WITH THERMAL REGENERATION XIV THERMALLY REGENERABLE RESIN SYSTEMS WITH HIGH CAPACITIES,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Chemical Technology.
B. A. Bolto, K. H. Eppinger, M. B. Jackson, and R. V. Siudak.
Desalination, Vol 34, No 3, p 171-188, September, 1980. 3 Fig, 14 Tab, 13 Ref.

Descriptors: *Desalination processes, Ion exchange, *Resins, *Polymers, Desalination, Thermal regeneration, *Ion exchange resins, Acrylic acid, Triallyamine hydrochloride, Polymers.

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The development of later generations of thermally regenerable (TR) ion-exchange resins is traced from those formed from a solution of the monomers acrylic acid and triallylamine hydrochloride, which gives resins with no TR capacity, to those which have a TR capacity of 2.1 meq/g. The resins include those prepared from a solution or emulsion of monomers, amphoteric resins in which acidic and basic groups are attached to a preformed polymer by a chemical reaction, resins made by polymerizing a monomer (or monomer + crosslinker) inside a crosslinked resin, resins prepared by the graft polymerization of monomers onto polymers on which radicals have been generated and resins prepared by the polymerization of monomers around polymeric microparticles. (Balaban-Boston)
W82-06101

SCALE INHIBITION OF CALCIUM SULFATE BY A FLUIDIZED BED,
Technische Hogeschool, Delft (Netherlands).
J. A. M. Meijer, and G. M. Van Rosmalen.
Desalination, Vol 34, No 3, p 217-232, September, 1980. 7 Fig, 27 Ref.

Descriptors: Desalination, Desalination processes, *Desalination apparatus, *Flash distillation, Fluidized bed evaporator, *Heat exchanger tube, *Scale inhibition, *Calcium sulfate, Scanning electron microscopy.

In a heat exchanger tube of the MSF-FBE the scale inhibiting capacity of the fluidized bed with respect to calcium sulfate was investigated. In all experiments at concentration factors between 1 and 2, the hemihydrate solubility line could be passed to a certain extent within scale formation. The ultimately formed scale consisted of anhydrite except at the largest super-saturation for hemihydrate, where hemihydrate was formed. The highest top temperatures were reached when the brine was deaerated and nuclei were excluded. Scale deposition is prevented better by 2 mm glass particles than by 1 mm glass particles. The very first scale layer at the metal surface shows a very poor crystal habit. (Balaban-Boston)
W82-06104

HYDRODYNAMICS OF CONDENSATE FILMS ON FLUTED TUBE SURFACES. PART I,
Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
Desalination, Vol 34, No 3, p 233-247, September, 1980. 1 Tab, 10 Fig, 8 Ref.

Descriptors: Desalination, Hydrodynamics, *Desalination processes, *Liquid films, *Fluted tubes, *Navier-Stokes equation, *Heat transfer coefficients.

Hydrodynamic characteristics of liquid films in downward motion on the outer surface of fluted tubes have been investigated, both experimentally and theoretically. The solution of the Navier-Stokes equation is aimed at expressing velocity distribution, volumetric flow-rate, friction and cross-sectional area as a function of flute geometry and operating conditions. A general practical relationship has also been derived for the liquid carrying capacity of different flutes. The results provide sufficient information pertaining to the thickness of the condensate film and its variation, thus enabling the prediction of heat transfer coefficients in desalination. (Balaban-Boston)
W82-06105

EFFECT OF SURFACE CONFIGURATION ON HEAT TRANSFER BY THE CONDENSATION OF STEAM OVER FLUTED SURFACES. PART II,
Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
In: Desalination, Vol 34, No 3, p 249-265, September, 1980. 3 Tab, 9 Fig, 10 Ref.

Descriptors: Desalination, *Desalination apparatus, Hydrodynamics, Pilot plants, *Heat transfer, *Film coefficients, *Fluted tubes, Condensation.

Heat transfer characteristics of fluted tubes have been determined by a pilot-plant study. Film coefficients (inside, outside and overall) have been expressed as a function of average liquid velocity. The performance of fluted tubes has been evaluated with respect to flute geometry and operating conditions by considering the hydrodynamic state of the condensate film. A 'geometric criterion' has been formulated to compare fluted tubes of different geometric designs with respect to their performance in heat transfer. (Balaban-Boston)
W82-06106

TRANSFER CHARACTERISTICS OF CONVEX AND CONCAVE RIVULET FLOW ON INCLINED SURFACES WITH STRAIGHT-EDGED GROOVES,
Technion - Israel Inst. of Tech., Haifa.
R. Semiat, D. Moalem-Maron, and S. Sideman.
In: Desalination, Vol 34, No 3, p 267-287, September, 1980. 13 Fig, 25 Ref.

Descriptors: Desalination, *Desalination apparatus, *Heat transfer coefficients, Convex-Concave rivulet flow.

The flow and temperature fields are solved for convex rivulet flow on the crest of a straight-edged groove and for concave rivulet flow in the bottom of the groove. The effect of the plane inclination in the range of $0 < \text{alpha} < \text{pi}$ is accounted for. The general solution converges to the case of flow on a vertical wall where $\text{alpha} = \text{pi}/2$. Solutions for the heat transfer coefficients are presented for boundary conditions of constant flux, constant temperature or constant resistance at the wall. The results are presented for aluminium-water system at 70 deg C with a constant contact angle of 37.7 deg. (Balaban-Boston)
W82-06107

ENHANCED HEAT TRANSFER IN HORIZONTAL EVAPORATOR-CONDENSERS WITH STRAIGHT-EDGED GROOVED TUBES,
Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Chemical Engineering.
D. Moalem-Maron, R. Semiat, and S. Sideman.
Desalination, Vol 34, No 3, p 289-309, September, 1980. 13 Fig, 21 Ref.

Descriptors: Desalination, Desalination processes, Distillation, *Desalination apparatus, *Heat transfer, *Evaporator-condensers(Horizontal).

The flow characteristics on a grooved surface depend on the external feeding rate and the overflow from the crest to the valley between the crests. Energetic considerations affecting transition from convex to concave rivulets are presented. The limiting bounds for minimum and maximum flow with full wetting of the groove determine the desired range of practical operation with different groove dimensions. The corresponding average groove-side heat transfer coefficients are presented. Overall heat transfer coefficients for the simultaneous evaporation-condensation process were calculated for various operating conditions and different grooved surfaces. Comparison with experimental data is satisfactory, but nevertheless indicates lack of availability of reliable data for the dynamic solid-liquid contact angle. (Balaban-Boston)
W82-06108

STUDIES ON SYNETHESES AND PERMEABILITIES OF SPECIAL POLYMER MEMBRANES.28. PERMEATION CHARACTERISTICS AND STRUCTURE OF INTERPOLYMER MEMBRANES FROM POLY(VINYLIDENE FLUORIDE) AND POLY(STYRENE SULFONIC ACID),
Kansai Univ., Osaka (Japan). Dept. of Chemistry.
T. Uragami, M. Fujimoto, and M. Sugihara.
Desalination, Vol 34, No 3, p 311-323, September, 1980. 2 Tab, 6 Fig, 15 Ref.

Descriptors: Desalination, *Membranes, *Membrane processes, *Polymer membranes, Poly(vinylidene fluoride), Poly(styrene sulfonic acid).

The permeation characteristics of poly(vinylidene fluoride) -poly(styrene sulfonic acid) interpolymer membranes in the separation of polymers, poly(ethylene glycols), from their aqueous solutions were investigated under various conditions. The permeation characteristics were influenced markedly by the casting solution composition and operating temperature. It was seen by scanning electron photomicrographs that the changes of ratio of poly (vinyliden fluoride)-poly(styrene sulfnic acid) were related to the changes of microporous structure of the resulting membranes. The permeation rates for aqueous solutions of poly(ethylene glycols) were greater than for pure water. It was found that this phenomenon was dependent on the physical and chemical natures of the membranes and the permeating molecules. The permeation mechanism through the interpolymer membranes was not only the viscous flow. (Balaban-Boston)
W82-06109

RO, MSF AND VTE/VC DESALINATION: A COMPARATIVE EVALUATION,
Envirogenics Systems Co., El Monte, CA.
I. Kamal, D. K. Emmermann, and G. F. Tusel.
Desalination, Vol 33, No 3, p 229-240, June, 1980. 5 Fig, 3 Tab, 3 Ref.

Descriptors: Desalination plants, *Desalination processes, *Reverse osmosis, Cost comparisons, *Multistage flash distillation, *Evaporators.

For seawater conversion in single-purpose plants, reverse osmosis is shown to be more economical than multistage flash desalinatiion over a wide range of unit size and fuel cost. Attention is focussed on vertical tube evaporation/vapor compression, a self-contained, low-energy consuming thermal process which is potentially competitive with RO. (Balaban-Boston)
W82-06110

MAGNESIUM OXIDE PRODUCTION FROM CONCENTRATED BRINES,
L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, V. Brandani, G. Di Giacomo, and P. U. Foscolo.
Desalination, Vol 33, No 3, p 241-250, June, 1980. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Desalination wastes, Desalination plants, *Brine wastes, *Magnesium oxide, Calcium sulfate, Capital costs, Operating costs.

Magnesium oxide production from concentrated brines wasted in sea water desalting plants has been investigated. Unlike traditional Mg recovery plants from sea water, it is necessary to undertake purification of the precipitated magnesium hydroxide by means of a carbonation-decarbonation section in order to remove calcium sulphate impurities. Such an operation gives flexibility to the whole plant and allows a high purity product to be obtained. This note illustrates all the stages of the proposed process together with the relevant operating conditions. In comparison with the traditional Mg recovery plants from sea water, it has also been found that the capital and operating costs related to the carbonation-decarbonation section are substantially balanced by the elimination of the sea water intake and of the feed pretreatments, as well as by the reduction of the flow rates to be handled in the first plant section. (Balaban-Boston)
W82-06111

HEAT TRANSFER IN A ROTATING DISK EVAPORATOR,
California Univ., Berkeley. Sea Water Conversion Lab.
C. S. Wang, R. Greif, and A. D. K. Laird.
Desalination, Vol 33, No 3, p 259-268, June, 1980. 8 Fig, 9 Ref.

Descriptors: Desalination, *Desalination equipment, *Heat transfer, *Evaporators, Rotating disk evaporator, Copper, Monel.

Experiments were carried out in a rotating disk evaporator with and without a wiper on the evaporation side. The tests were carried out with copper and with monel disks. Overall heat transfer coefficients were obtained directly from the measurements. In addition, evaporation heat transfer coefficients were calculated and the results were correlated. The effectiveness of the wiped film evaporator was clearly manifested in the larger heat transfer coefficients that were obtained. (Balaban-Boston)
W82-06112

SOME BASIC OBSERVATIONS ON HEAT TRANSFER AND EVAPORATION IN THE HORIZONTAL FLASH EVAPORATOR,
Pennsylvania Univ., Philadelphia.
N. Lior, and R. Greif.
Desalination, Vol 33, No 33, p 269-286, June, 1980. 10 Fig, 1 Tab, 24 Ref.

Descriptors: Desalination, *Distillation, Horizontal flash evaporator, *Heat transfer, *Evaporators.

This paper describes a study of the heat, mass and momentum transport associated with vapor release in a horizontal stage of a flash evaporator. A scaled-down, well-controlled flash evaporator, which also allows good visual observation, has been designed constructed and used in the experiments. In paticular, temperature profiles in the stage have been measured to an accuracy of + 0.02 deg C and better. It has been determined that the subcritical flow in the flash stage consists of two principal regions: submerged sluice gate flow with the associated hydraulic pump overlayed by a backflow roller, followed by open channel flow. The flashing of NaCl solutions was accompanied by strong foaming, which has reduced the fractional non-equilibrium allowance by a factor of two or three, without impairing the purity of the distillate. (Balaban-Boston)
W82-06113

MYTHS ABOUT FREEZE DESALTING,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
H. F. Wieandt, and R. L. Von Berg.
Desalination, Vol 33, No 3, p 287-298, June, 1980. 4 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, *Desalination processes, Freezing, *Freeze desalting.

Since the inception of freezing as a process for desalting sea water, a variety of misconsceptions about the process have evolved and persisted, even when countered with scientific and engineering information to the contrary. Such misconceptions or myths have been very damaging to the commercial development of freezing as a competitive desalination process. A number of these myths are explored with respect to their engineering validity and a comparison is made between freezing and other important desalination processes. (Balaban-Boston)
W82-06114

FREEZING PROCESSES - THE STANDARD OF THE FUTURE - AN UPDATE,
Schroeder Process Corp., Santa Ana, CA.
P. J. Schroeder.
Desalination, Vol 33, No 3, p 299-310, June, 1980. 3 Fig, 6 Ref.

Descriptors: *Desalination plants, Desalination processes, Freezing, *Freeze desalting.

A previous work took the position that freezing processes would be the standard of the future, at least in cases where the feedwater has the concentration of sea-water or higher. It then summarized Fluor's ongoing work on a 10,000 gpd eutectic freezing pilot plant and a freeze desalting plant using the 'cold' from an LNG plant. This work focuses primarily on the progress in coupling a freeze desalting plant to an LGC vaporizer. (Balaban-Boston)
W82-06115

A COMPREHENSIVE FORMAL APPROACH TO THE EVALUATION OF BIDS FOR DESALINATION PLANTS USING VERBAL JUDGEMENT,
Science Applications, Inc., Ames, IA.
R. Kenarangui, A. Husseiny, and Z. Sabri.
Desalination, Vol 33, No 3, p 311-331, June 1980. 10 Fig, 6 Tab, 5 Ref.

Descriptors: Desalination, *Desalination plants, Economics, Social aspects, Safety, Environmental consideration, Political aspects, *Cost analysis.

Evaluation of competitive bids for large engineering projects such as desalination plant construction requires careful consideration of several factors other than pure economic merits; namely, technical characteristics of bids, the socio-political situation, safety merits, environmental aspects, public acceptance and other non-financial aspects. A method is developed here based on verbal judgement and fuzzy set theory to allow for comprehensive and systematic formal evaluation of bids. The method is applied to a case study and can be directly used by the technical team to make the final conclusion. The method is implemented in the form of a computer code (MAFDA) which is suitable for interactive computer facilities. (Balaban-Boston)
W82-06116

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,
Ben-Gurion Univ. of the Negev, Beersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 2, p 123-138, May, 1980. 5 Fig, 6 Tab, 15 Ref.

Descriptors: *Recycling, Waste recovery, *Ion exchange, Desalination, Wastewater treatment, Operating costs.

Recycling of waste water by ion-exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime fluocculation, served as a feed for the ion-exchange system. It was found that both the salt concentration and the organic matter content of the effluent could be reduced to produce high quqlity water, suitable foor a wide range of agricultural and industrial applications. Salt concentrations was reduced from 15 meq/1 (750 ppm as CaCO3) to about 1 meq/1 (50 ppm as CaCO3) and the organic matter, from 70-100 mg/1 COD (chemical oxygen demand) to 20 mg/1. The anion exchanger was regenerated with Ca(OH)2 according to a new method recently developed. The treatment cost for a 2000 m(3)/day plant was calculated to be 18.0 cents/cu m. (Balaban-Boston)
W82-06118

MASS TRANSFER IN THE U-TURN OF AN ELECTRODIALYZER,
Korea Advanced Inst. of Science, Seoul. Dept. of Chemical Engineering.
I. H. Kim, I. S. Kang, and H. N. Chang.
Desalination, Vol 33, No 2, p 139-161, May, 1980. 12 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, Desalination processes, *Electrodialysis, Hydrodynamics, *Mass transfer, Spacers.

As a link in the chain of the hydrodynamic theories on electrodialysis, the mass transfer rate in the U-turn of a tortuous spacer was investigated. Besides, the solutions by Sonin and Probstein (1968) for a straight channel geometry were modified using a concentration profile approximated with a third order polynomial. The flow in a U-turn geometry at low Reynolds numbers was analyzed with the aid of the potential flow theory, and the related mass transfer problem was solved in connection with the flow field solution for the U-turn and the revised concentration distribution. Theoretical analysis showed that the desalting efficiency in the U-turn was nearly the same as that in the straight channel for low polarization but the efficiency was lower for high polarization. Experimental results for the U-turn geometry were in good agreement with the theory for the case of low polarization. However the discrepancy between the two was noticeable for the case of high polarization. Also the disagreement became more pronounced at higher flow velocities possibly owing to the formation of a secondary flow caused by centrifugal forces. (Balaban-Boston)
W82-06119

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,
Mobil Oil A.G., Celle (Germany, F.R.).
G. Wilken.
Desalination, Vol 33, No 2, p 21-210, May, 1980. 4 Fig, 18 Ref.

Descriptors: Water purification, *Scale formation, Additives, Crystal growth inhibitors, *Scaling, *Calcium carbonate prevention.

Additives which act non-stoichiometrically during the threshold treatment process are of interest for the control of water formed deposits in water purification or circulation systems. The relevant literature describes the mechanism of the process to prevent precipitation of calcium carbonate. Scale deposition can be reached by adding certain compounds, which are generally polymers or polyelectrolytes, to the solution. Such additives act as crystal growth inhibitors by being adsorbed onto the growing faces of submicroscopic crystals or crystallites. At low supersaturation this gives a stable colloid which can be carried out of the reaction zone by the fluid. In the particular case of a highly supersaturated solution the common additives are not sufficiently effective in preventing scale deposition. The purpose of this paper is to develop a water treatment based on the crystal growth distortion by the scale-inhibitors to produce aggregates which are removable by gas or liquid. The present investigation examines the ability of commercially available scale-inhibitors, stable in aqueous solutions above 100 degree C, to prevent regular calcium carbonate crystal growth. The effectiveness of scale-inhibitors is predominantly concerned with alterations in crystal habit and in characteristics of the precipitate morphology. (Balaban-Boston)
W82-06120

CRITICAL ANALYSIS OF A PROPOSED SOLAR ASSISTED HTE DESALINATION SYSTEM,
Sidney Univ. (Australia).
G. G. Fenton, and J. P. Gerofi.
Desalination, Vol 33, No 2, p 211-220, May, 1980. 6 Fig, 6 Ref.

Descriptors: Desalination, Desalination processes, *Solar assisted desalination, Cost analysis.

A solar assisted desalination system proposed by Gasparini et al. is reviewed. The authors show that there are errors and misconceptions in the paper that render its conclusion invalid. Factors that should be considered in a rigorous analysis of the problem are outlined. Contrary to the original conclusions the current analysis shows that a flat plate collector system is a more attractive proposition than a concentrating option, and that the actual payback periods for the options proposed are unacceptably long at present fuel oil prices. (Balaban-Boston)
W82-06121

ANALYSIS OF LARGE DESALINATION PLANTS,
L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, D. Bogazzi, A. Germana', and G. Tagliaferri.
Desalination, Vol 33, No 1, p 1-10, April, 1980. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Desalination, *Desalination plants, *Desalination processes, Distillation, *Multi-flash distillation, Construction, Operation, Reliability, Economics, Unit size.

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The experience achieved in the construction and operation since 1973 of the larges MSF desalination unit in the world (8 migd) is the basis for a detailed analysis aimed at contributing to the determination of the practical top size of such units. Taken into account are the reliability and engineering problems as well as economic aspects deriving from the multi-stage flash (MSF) unit size. The problem assumes particular interest when related to the actual trend to limit the maximum unit size normally to 5 migd and in a few cases 6 migd so that consequently some water stations have a large number of parallel units. (Balaban-Boston)
W82-06122

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5D.
W82-06123

MSF DESALINATION PLANTS, AVAILABILITY, RELIABILITY AND SAFETY ANALYSIS,
Science Applications, Inc., Palo Alto, CA.
A. Unione, E. Burns, and A. A. Husseiny.
Desalination, Vol 33, No 1, p 49-84, April, 1980. 14 Fig, 6 Tab, 51 Ref.

Descriptors: Desalination, *Desalination plants, *Performance evaluation, *Multistage flash distillation, Seawater, Availability, Reliability, Safety analysis.

While good MSF desalination plant performance exerts a positive influence on plant economics, as part of water supply systems in isolated regions, the availability of the desalination system becomes a major design criterion. Reliability problems have historically been a major cause of poor performance for desalination plants. The emphasis of this paper is on the importance of availability modeling methodology to MSF desalination plant reliability problems by providing a context in which the effect of unit unavailability can be quantified. An assessment is made of failures and outages which impact the availability of MSF desalination plants. Limited fault tree logic for system failures is developed and reliability data from the literature is incorporated, where possible. The impact of other water supply system failures on the reliability requirements of the desalination plant is quantified as are the effects of increased average water system demands. The single largest influence on the effective capacity of a water supply system based on MSF desalination of sea water is found to be the availability and maintainability of the desalination plant. Forced outages as a result of equipment failure are significant, but other dominant contributions to unit unavailability include externally caused problems, such as silting. The design configuration of the desalination plant is also found to have an impact on the acceptability of water supply system performance. (Balaban-Boston)
W82-06124

ABSORPTION FREEZING VAPOR COMPRESSION - PROCESS SELECTION, PILOT PLANT DESIGN, PROCESS ECONOMICS,
Concentration Specialists, Inc., Andover, MA.
James H. Fraser.
Desalination, Vol 33, No 1, p 85-98, April, 1980. 4 Fig, 7 Tab.

Descriptors: *Desalination plants, Desalination processes, *Freezing, *Vapor compression, Economics, Pilot plants, Capital costs, Operating costs.

A 25,000 gpd Absorption Freezing Vapor Compression (AFVC) pilot plant was built. Additional studies were conducted in order to prepare capital and operating cost estimates on 100,000 and 1,000,000 gpd plants. AFVC is a new freezing process for desalination and other concentration/separation applications that uses an absorption cycle powered by a heat pump. Power consumption of 42 and 38 kWh/1000 gal. were calculated for the 100,000 and 1,000,000 gpd plants respectively. The 25,000 gpd pilot plant consists of three major process vessels freezer/absorber, wash column/melter, and generator - and two equipment skids - one for the refrigeration equipment and one for the pumps, air removal equipment and heat exchangers. (Balaban-Boston)
W82-06125

MATERIAL SPECIFICATION AND THE AVAILABILITY AND LIFE OF DESALINATION EQUIPMENT IN BOTH SAUDIA ARABIA AND THE ARABIAN GULF,
Conan/Temperley and Associates, Jeddah (Saudi Arabia).
Tom G. Temperley.
Desalination, Vol 33, No 1, p 99-108, April, 1980.

Descriptors: Desalination, *Desalination equipment, *Specifications, *Evaporators, *Materials engineering, *Saudi Arabia, Arabian Gulf.

The author describes operational experience with various materials of construction in both low temperature polyphosphate treated evaporators and also in high temperature evaporators using acid treatment. The author references the repeated use of unsuitable materials and proposes a solution by the development of more detailed and positive specifications for plant and equipment. A problem faced by many manufacturers is the fact that as a result of broad, open specifications they are forced to use inferior materials in order to remain competitive. The author discusses the use of both corrosion resistant linings and operating experience. In summary, the paper correlates the operating conditions with selection of materials. (Balaban-Boston)
W82-06126

SALBUKH REVERSE OSMOSIS PLANT ON STREAM,
Vattenbyggnadsbyran Ltd., Stockholm (Sweden). Dept. of Water, Soil and Environment Development.
B. Ericsson.
Desalination, Vol 33, No 1, p 109-114, April, 1980. 1 Fig, 3 Tab, 1 Ref.

Descriptors: Desalination, *Desalination plants, *Reverse osmosis, Pretreatment, Performance evaluation, Salbukh.

An inspection test on the RO plant at Salbukh treatment plant was carried out for 96 hours. The RO plant was successfully brought into operation and the requirements on water quality, water production and water losses satisfied. Based on the performance test, VBB recommends that the RO installation be accepted. Raw water cooling in the pretreatment plant is, however, not acceptable at present. The RO feed water temperature was about 38-40 degree C instead of about 35 degree C due to the lower efficiency of the coolers than calculated, a failure to be rectified by the Contractor. During the last few months the pretreatment of raw water from Well 54 at Buwayb has been investigated by Ames Crosta Babcock by means of final operation of a pilot plant. Based on these results, the use of 140 mg/1 lime and 100 mg/1 soda for chemical softening has been recommended by VBB. The high TDS of the raw water in Well 54 indicates that the final blended water at the same water production rate as originally designed, will contain around 750 mg/1 TDS. However, there is now an indication that the average TDS with all the deep wells in operation will be around 650 mg/1 in blended water due to the low average TDS in the raw water. The pretreatment plant at Buwayb was partly brought into operation in October/November, and the pretreated water is discharged into the water disribution net and blended with desalinated water from Salbukh. (Balaban-Boston)
W82-06127

THE DEVELOPMENT OF DRY-RO MEMBRANES FROM CELLULOSIS AND NONCELLULOSIS POLYMERS BEARING QUATERNARY AMMONIUM GROUPS,
Puropore, Inc., Tustin, CA.
R. E. Kesting.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243676, Price codes: A03 in paper copy, A01 in microfiche. Report, June 1981. 43 p, 3 Fig, 20 Tab. OWRT C-00133-S(0463)(1), 14-34-0001-0463.

Descriptors: *Reverse osmosis, *Cellulose acetate membranes, *Membranes, *Ion exchange, *Synthesis, Membrane processes, Chlorination, Wastewater treatment, Membrane filters, Polymers, Physicochemical properties, Structure, Physical properties, Chemical properties, Chemical reactions, Fabrication, Evaluation, Water treatment.

Studies were carried out on reverse osmosis (RO) membranes prepared from both cellulosic and noncellulosic materials. For cellulosic membranes produced from quarternized cellulose triesters (QCTE), a successful resolution was achieved to the problems of their high cost and less than optimum reproducibility for dry RO membranes. Blends of QCTE polymer which contained two and three times the optimum ion-exchange capacity (x) could be blended with one or two parts, respectively, of neutral cellulose acetate to yield blend membranes with equivalent performance to those prepared from a homopolymer QCTE with an ion-exchange capacity of x. For noncellulosic membranes, it was found impractical to introduce quarternary ammonium groups into polysulfone. In attempting to find other suitable noncellulosic polymers, aromatic polyamides (specifically, various piperazine phthalamides) were investigated. It was discovered that piperazine ortho-phthalates were sufficiently soluble in methylene chloride/isopropanol (an excellent dry process solvent system) as to permit fabrication of integrally-skinned wet-dry reversible RO membranes. This class of polyamides are thermally-stable and chlorine-resistant, and may lead to a universally applicable RO membrane. (Zielinski-MAXIMA)
W82-06152

ORIENTED MONOLAYER ASSEMBLIES TO MODIFY FOULING PROPENSITIES OF MEMBRANES.
Southern Research Inst., Birmingham, AL.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254913, Price codes: A06 in paper copy, A01 in microfiche. Report SORI-EAS-81-635, July 1981. 108 p, 52 Fig, 7 Tab, 50 Ref, 1 Append. OWRT C-000-99-S(0440)(1), 14-34-0001-0440.

Descriptors: *Membrane processes, *Anion exchange, *Membranes, *Monomolecular films, *Fouling, Ion exchange, Synthesis, Thin films, Polarization, Microscopic analysis, Humic acid, Biodegradation, *Desalination processes, Desalination apparatus, Demineralization, Saline water.

Research was conducted to test whether oriented monomolecular-layer assemblies bearing positive charges would mitigate the fouling propensities of anion-exchange membranes, especially if the oriented layers were fluorinated. Fouling tests with membranes coated by oppositely and similarly charged multilayers should also demonstrate the relative importance of several membrane surface characteristics earlier shown to play roles in initiation of autocatalytic concentration polarization and fouling. Membrane surfaces were modified by coating with individually-oriented layers of amphiphilic modules (having polar and non-polar ends), using the classical Blodgett dipping technique. It was determined that, with appropriate selection of amphiphilic compounds and packing densities, it was possible to independently vary hydrophilicity, homogeneity, and rugosity, thereby establishing the relative importance of these factors in the fouling process. Even a single deposited oriented monolayer of 20 A thickness strikingly modified the microscopic appearance and the electrical and fouling behaviors of anion-exchange membranes. (Zielinski-MAXIMA)
W82-06167

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. C. Stitt, C. A. Loeser, J. M. Hodgson, and G. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234162, Price codes: A10 in paper copy, A01 in microfiche. Report REC-ERC-81-14, May 1981. 217 p, 32 Fig, 2 Tab, 4 Ref, 7 Append.

Descriptors: *Monitoring, *Desalination plants, *Plugging factor, *Water treatment, Particulate matter, Colorado River, Drainage water, Computers, Salinity.

The Yuma Desalting Test Facility was constructed to provide data needed for the design of the proposed Yuma Desalting Plant, near Yuma, Arizona. This plant would provide drainage water treatment for the Wellton-Mohawk Irrigation and Drainage District. The plant would subsequently reduce the salinity of Colorado River water delivered to Mexico. The instrumentation requirements for the test facility include monitoring the plugging factor of the water at various points in the water pretreatement process. The measurement of this factor is used to indicate the amount of organic and inorganic particulate matter which is suspended in the water. To automate the measurement process, a controller was needed for the measuring device. The function of the Plugging Factor Monitor Electronic Controller is to provide plugging factor measurements on any or all of the six possible sample streams. The Plugging Factor monitor can be incorporated into any water treatment facility where the measurement of a plugging factor is required. (Moore-SRC)
W82-06398

APPARATUS FOR DESALINATING WATER,
R. E. Diggs.
U.S. Patent No 4,203,806, 18 p, 21 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 975-976, May 20, 1980.

Descriptors: *Patents, *Water treatment, Water purification, *Desalination processes, Desalination apparatus, Solar radiation, Desalination wastes, Distillation, Vapor compression distillation, Solar distillation.

Contaminated water flows across a grid and into a storage tank. The grid utilizes solar energy to heat that water to a predetermined temparature. A heat transfer structure which is dome-shaped and receives water from the storage tank and a preheater utilizing solar energy heats the water to a further predetermined temperature. An evaporator receives the heated water and exposes it to a vacuum condition so that the temperature of the water is above the saturation temperature. The water is thus vaporized, and solid contaminants dissolved. The solids are deposited on moving belts and are then moved into a solids removal system comprising trap door pairs upon which the solids are deposited and which are sequentially opened so that the vacuum conditions existing in the evaporator are not disturbed. Vapor transferring means remove the water vapor from the evaporator and transfers it to the heat transfer structure where it is condensed to form distillate which is free of contamination. The distillate is removed to a collection tank. (Sinha - OEIS)
W82-06711

MOLECULAR (OSMOTIC AND ELECTRO-OSMOTIC) BACKWASH OF CELLULOSE ACETATE HYPERFILTRATION MEMBRANES,
California Univ. Berkeley. Sea Water Conversion Lab.
K. S. Spiegler, and J. H. Macleish.
Journal of Membrane Science, Vol 8, No 2, p 173-192, March, 1981. 9 Fig, 24 Ref.

Descriptors: *Backwash, *Desalination apparatus, *Hyperfiltration, Membrane processes, *Cellulose acetate, membranes, *Osmosis, *Electro-osmosis, *Molecular backwash, Salt rejection, Filtration, Saline water.

A molecular backwash technique, developed to clean and rejuvenate contaminated asymmetric cellulose acetate membranes used in desalting plants, was based on osmosis and/or electro-osmosis. When the membranes were contaminated with ferric hydroxide, they showed substantial resistance to mass transfer and considerable flux decrease. Four types of backwashing experiments were performed: (1) osmotic backwash with no flushing, (2) osmotic backwash with flushing with deonized water, (3) and (4) electro-osmotic backwashing with and without flushing, applying as electric current (typical current density,-32mA per sq cm) to the membrane for 20-30 min. In all cases the hyperfiltration pressure was lowered to 5-30 psi during backwashing and raised to 6000 psi to continue filtration. After molecular backwashing, flux loss recoveries were 30-100%. In some cases the salt rejection loss which had occurred during contamination was partially restored. Electro-osmotic backwash was more beneficial than osmotic backwash. (Cassar-FRC)
W82-06792

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,
Scientific Research Inst. of Plastics, (USSR).
For primary bibliographic entry see Field 5D.
W82-06988

3B. Water Yield Improvement

CHINA'S AGRO-ECOSYSTEM,
Manitoba Univ., Winnipeg. Dept. of Geography.
V. Smil.
Agro-Ecosystems, Vol 7, No 1, p 27-46, 1981. 2 Fig, 4 Tab, 45 Ref.

Descriptors: *Agriculture, *Irrigation, Water resources development, *Environmental effects, Land management, *China, Soil erosion, Water pollution, Aquaculture, Drainage, Water transfer, Pumping, Water management.

Regional lack of moisture is a critical environmental constraint to China's agro-ecosystem. The climate ranges from subtropical in the southeast to arid in the north and northwest. Mean annual precipitation varies from 577 mm to 1720 mm. In some areas evaporation exceeds precipitation by up to 4 times. Water resources development and control have been an integral part of China's agriculture for centuries. As of 1979 the irrigation system included 80,000 reservoirs, 5000 canal networks, and 2 million power operated wells. Several large multipurpose water projects are under construction. Aquaculture has deteriorated in recent years because of pollution, dam building, and land reclamation. The capacity of agricultural pumps for drainage and irrigation was 47 GW in 1978, a large increase from 0.13 GW in 1950. China's agricultural system faces many problems. The mechanical irrigation systems are not efficient. Leaks and seepage losses are 50-60%, power shortages idle the pumps for long periods, and sprinkler irrigation is in an early stage of development. Soil erosion is a wide-spread and serious environmental problem, caused by land mismanagement. A proposed water transfer from the Yangzi basin to the chronically dry north also poses environmental hazards. (Cassar-FRC)
W82-06019

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
D. S. Mull, S. Cordiviola, and D. W. Risser.
Geological Survey Open-File Report 81-690 (WRI), 1981. 51, p 14 Fig, 2 Plates, 12 Tab, 35 Ref.

Descriptors: *Groundwater, *Available water, *Water quality, *Coal mines, Mine drainage, Recharge, Precipitation, Streams, Water demand, Water analysis, Chemical analysis, Potential water supply, *Kentucky, Johnson County, Martin County.

The location and mine volume is shown for all abandoned coal mines that contained water in Johnson and Martin Counties, Ky. The principal factors that affect the occurrence of water in coal mines is mine size, intensity and duration of precipitation and the location of the mine relative to the nearest perennial stream. Water usually flows from mines that were developed above drainage whereas water usually must be pumped from flooded galleries of mines below drainage. Ten above-drainage mines discharged from 12 to 1,700 gallons of water per minute. Sustained discharge from the largest above-drainage mine ranged from 750 to 1,200 gallons per minute. Eight below drainage mines are considered potential sources of water. Test pumping and hydrographs indicate the seasonal recharge rate into below drainage mines varies from 660 to 103,500 gallons per day. Estimates of water stored in individual mines ranged from 22 to 1,462 million gallons. This water could sustain a supply through periods of limited recharge to the mine. Most mine water is a calcium magnesium sulfate type. Hardness ranged from soft to very hard and pH ranged from 3.1 to 8.0 units. The concentration of most dissolved constituents was lower in water from below-drainage mines than in water from those above-drainage. (USGS)
W82-06136

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,
Illinois State Water Survey, Champaign.
For primary bibliographic entry see Field 6B.
W82-06176

CAVE WATER--JAVA'S HIDDEN RESOURCE,
A. Bingham.
World Water, Vol 5, No 5, p 49-51, May, 1982. 1 Fig.

Descriptors: *Water supply, *Developing countries, *Caves, Wells, Groundwater availability, Aquifers, Exploitation, Sinkholes, Underground streams, Java, *Indonesia.

In the dry summer season villagers in the Yogyakarta region of Indonesia must walk up to 15 km to obtain drinking water from clay floor sinkholes and caves in the fissured limestone hills. The presence of water in these places has prompted renovation of the sinkholes by sinking shaft wells. This water supply, filtered by the clay, is cleaner and more reliable than surface pools. Most cave water is obtained from shallow dirty pools near the entrances. However, underground streams and large pools have been discovered in some caves. It is believed that these less accessible, but more abundant, supplies may be tapped by sinking well shafts, removing rock, or installing pumps. (Cassar-FRC)
W82-06605

3C. Use Of Water Of Impaired Quality

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
M. W. Nabors.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243445, Price codes: A07 in paper copy, A01 in microfiche. Report No 109, October 1981. 133 p, 16 Ref, 7 Append. OWRT B-208-COLO(1), 14-34-0001-0211.

Descriptors: *Culturing techniques, *Water stress, *Salt tolerance, *Water use efficiency, Plant pathology, Stress, Median tolerance limit, Plant growth, Crop production, Crop yield, Water use, Tobacco, Oats, Wheat, Coastal plains, Coastal waters, Arid climates.

Research has been carried out which demonstrates the usefulness of tissue culture to assess stress tolerance in plants. This technological approach is shown to be a useful vehicle for the assessment of

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agriculturally-useful plants that exhibit tolerance to low irrigation water supplies or salt water for enhancing food production in arid or coastal areas. The available methodology was improved and new methodology established. Available tissue culture methodology can be used to rapidly select NaCl-tolerant cell lines and to regenerate whole plants from those lines in tobacco, oats, and wheat. In tobacco, regenerated plants are salt-tolerant, pass this tolerance on to two generations of offspring, and give rise to tolerant callus when returned to tissue culture. Regenerated oat plants require a short period of exposure at 30 degrees to become established in pot culture, and exposure to about 20 degrees during the rest of the life cycle to set seed. In addition, initial studies on the mechanism of salt tolerance in cultured cells and regenerated plants have been completed. Future research should focus on the development and implementation of tissue culture methods to obtain increased efficiency of water utilization for agriculturally-useful plants. (Zielinski-MAXIMA)
W82-05920

WASTEWATER IRRIGATION OF FRUIT TREES,
Tuskegee Inst., AL. Dept. of Agricultural Sciences.
F. M. Basiouny.
BioCycle, Vol 23, No 2, p 51-53, March/April, 1982. 1 Tab, 52 Ref.

Descriptors: *Wastewater irrigation, *Irrigation water, *Fruit crops, Reviews, Orchards, Water reuse, Land application, Accumulation, Saline water, Heavy meals, Metals, Pathogens, Nutrients.

Wastewater irrigation of fruit trees has a two-fold benefit: addition of mineral and organic nutrients and renovation of the wastewater. This practice can save 25-50% in production costs. Most non-industrial wastewaters have salinity levels of 300-700 ppm, within the salinity range suitable for irrigation water. However, foliar spraying should be avoided in orchards. Potential problems in wastewater irrigation are toxicity or plant uptake of heavy metals and transmission of disease organisms. The heavy metal problems can be controlled with careful management. Pathogenic contamination of fruit tree products is very unlikely, since bacteria and viruses can be effectively removed by primary and secondary treatment. (Cassar-FRC)
W82-06008

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,
Riyadh University (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 5E.
W82-06228

EFFLUENT IN TRICKLE IRRIGATION OF COTTON IN ARID ZONES,
Ben-Gurion Univ. of the Negev, Sde-Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, J. Ben-Asher, and Y. DeMalach.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p115-126, June, 1982. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater irrgation, *Irrigation water, *Trickle irrigation, *Cotton, Arid lands, Beer-Sheva Vally, *Israel, Nutrients, Fertilizers, Crop yield.

Treated wastewater from facultative oxidation ponda was aplies to cotton on loess soil by tickle irrigation in the arid Beer-Sheva Valley, Israel, during 1980. Six trickle irrigation treatments and a sprinkler irrigation treatment were applied. Irritation itervals were 2,3,7, and 12 days; emitter discharges were 2,4, and 8 liters per hour; emitter spacing between rows, 1.92 and 2,88 m; and mitter spacing on laterals, 1.0. m. Cumulative water application was about 600 mm for the season in all treatments. The highest cotton yield, 604.1 kg per 1000 sq m, was produced by the smallest emitter discharge, smaller eitter spacing, and 2-day irrgation interval. The lowest yield, 375.6 kg per 1000 sq m, was produced by the largest emitter discharge, larger emitter spacing, and 12 day irrigation interval. No additional fertilizers were applies in any treatments. Proper screen filtration eliminated emitter clogging. (Cassar-FRC)
W82-06333

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5G.
W82-06400

EXPANDING OPTIONS FOR GREYWATER TREATMENT,
Lombardo and Associates, Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06491

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,
CH2M/Hill, Redding, CA.
S. C. Ebe, and S. M. Stroud.
Public Works, Vol 113, No 3, p 68-69, March, 1982.

Descriptors: *Food-processing wastes, *Impaired water use, *Land application, Wastewater treatment, Merced, California, Land disposal, Wastewater irrigation, Irrigation water, Crop land, Monitoring.

High strength food processing wastewaters are applied to city owned crop land in Merced, California, during the canning season, mid-August to mid-October. This procedure relieves the seasonal overload on the municipal wastewater system and allows the discharges to meet state requirements. The 985 acre disposal site, adjacent to the treatment plant, was plowed to a depth of 3.5 ft and gypsum added. Oat hay and wheat grain are grown. The system, which became operational in August 1979, consists of seven 80 acre fields with pump stations and piping. Wastewater can be delivered to any one or any combination of the seven fields via a 14 inch pipe. The flow is channeled through a head ditch to individual border checks. Runoff is returned to the head ditch. In the spring irrigation season secondary municipal effluent may be used as a supplement. The versatile system also allows the food wastewater to enter the municipal treatment plant during periods of low flow in winter and early summer. Drainage control structures were created for flood control. An adjacent 385 acre wetlands area receives secondary treated effluent. The project includes a water quality monitoring program. (Cassar-FRC)
W82-06507

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,
Williamsport Sanitary Authority, PA.
M. H. Gerardi, O. A. DeParasis, and W. H. Falk.
Public Works, Vol 113, No 3, p 59-60, March, 1982. 1 Fig, 2 Tab.

Descriptors: *Water conservation, *Impaired water use, Wastewater treatment, *Treatment plants, Effluents, Williamsport, Pennsylvania.

Two Williamsport, Pennsylvania, wastewater treatment plants reduced water usage by about 60% during a period of drought in early 1981. Average daily consumption for the Central plant was 12,500 gal in 1979-80 and 6,000 gal in 1981; for the West plant, 6,000 gal in 1979-80 and 2,000 gal in 1981. Conservation measures consisted of minimizing use of potable water and maximizing use of secondary effluent. Flow restrictors, new water faucet washers, and three-minute showers saved potable water. Effluent was used to wash equipment, floors, vehicles and treatment tanks, and to launder rags. Other uses of effluent included sprinkling scum on secondary clarifiers, packing glands for the raw sewage pumps, concrete curing, cleaning bar screens, hosing foam, flushing lines, and lubricating sludge pump pistons. (Cassar-FRC)
W82-06512

A COMPARISON OF THE EFFECTS OF SALINITY ON PHOTOSYNTHETIC PHYSIOLOGY OF A SALT SENSITIVE GRASS, PANICUM OBTUSUM, AND A SALT TOLERANT GRASS, DISTICHLIS SPICATA,
New Mexico State Water Resources Research Inst., Las Cruces.
P. R. Kemp, and G. L. Cunningham.
New Mexico Water Resources Research Institute, Report No 143, March 1982. 19 p, 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salinity, *Saline soils, *Saline water, *Salt tolerance, *Grasses, Photosynthesis, Assimilative capacity, Stomata, Growth rates, Growth media, Halophytes, Temperature effects, Plant water potential.

Utilizing salt tolerant crops could potentially increase agricultural productivity in the southwest by using brackish water from vast underground resources or through increased growth on salt-damaged fields. Selecting and breeding salt tolerant crops requires an understanding of the physiological and anatomical mechanisms of salt tolerance. A salt sensitive grass and a salt tolerant grass were the subject of this experiment on the effects of substrate salinity. There were three experimental treatments, all in a controlled environment, for each species. Preliminary results showed marked differences in salinity tolerance. D. spicata grows well in solution cultures up to 500 mM NaCl. P. obtusum dies rapidly in salinities over 250 mM NaCl and will not grow in salinity greater than 125 mM NaCl. An unexplained difference is P. obtusum's poor growth in solution culture as compared to D. spicata. The temperature response curves of net photosynthesis show that maximal rates occur near 40 C for both species with no added NaCl. However, rates of net photosynthesis were quite different between species at all leaf temperatures when grown without NaCl---the rates of D. spicata were twice those of P. obtusum. Growing plants at high salinity reduced net photosynthesis in both species by causing increases in both stomatal and internal resistances to CO2 assimilation. Resistance of P. obtusum was higher than D. spicata in all treatments; thus, D. spicata has a more efficient internal CO2 assimilation mechanism. Leaf water potentials in both species declined with increasing salinity. (Atkins-Omniplan)
W82-06521

AQUACULTURE FOR WASTE MANAGEMENT,
Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W82-06556

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,
Denver Research Inst., CO.
J. G. Milliken, L. C. Lohman, and C. W. Howe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256694, Price codes: A05 in paper copy, A01 in microfiche. OWRT/RU-81/7 Report, August 1981. 87 p, 2 Fig, 13 Tab, 53 Ref, 4 Append. OWRT C-80228-R(8820)(1).

Descriptors: *River basins, *Impaired water use, *Economic aspects, *Saline water, *Monetary benefits, Water reuse, Cost-benefit analysis, Salinity, Tangible benefits, Water quality, Industrial water, Cooling water, Irrigation water, Electric powerplants, Benefits, Reclaimed water, *Colorado River basin.

The cost-effectiveness of selected financial incentives for encouraging reuse of low quality/saline water collected by the U.S. Bureau of Reclamation (USBR) system for electric power plant cooling is analyzed. Penalty costs to water users presently

using saline waters for agricultural/domestic purposes and the potential economic benefits in salinity reduction are identified. Non-quantifiable salinity control benefits were identified as well, in terms of existing/potential beneficial water uses in the 7 Colorado River basin States and general amenity benefits. Further the institutional/regulatory environment in which electric power plants must operate was examined and is described. Comparative costs for saline water reuse for power plant cooling were ascertained. In addition, financial/policy incentives were studied for their relevance to the public power utility and the utility regulatory agency, and for their implementation potential. The most like incentive (capital cost subsidy) was analyzed with existing representative power plant cost data to assess its economic potential. The average cost was below a number of current USBR salinity control projects under consideration for construction. Reuse of saline water by an electric power utility could be a viable and cost-effective method of salinity control. (Zielinski-MAXIMA)
W82-06693

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06707

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
S. T. Chu, and C. G. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256850, Price codes: A03 in paper copy, A01 in microfiche. South Dakota Water Resources Institute Report, May, 1982. 28 p, 7 Fig, 1 Tab, 38 Ref, 1 Append. OWRT A-074-SDAK(1), 14-34-0001-0144.

Descriptors: *Infiltration capacity, *Irrigation design, *Saline soils, *Soil water, *Mathematical equations, Infiltration coefficient, Infiltration index, Infiltration, Infiltration rate, Free water, Irrigation, Soil conservation, Soil contamination, Basins, Runoff coefficient, Sodium, Soil types, Field tests, Mathematical studies, Electrolytes.

Soil infiltration capacity (IC) must be considered for irrigation system design, soil conservation planning, and for evaluating basin runoff yields. The relationship of IC (inches/hour) as a function of electrolyte concentration (EC, meq/liter) of the saturation extract and the exchangeable sodium (Na) percentage (ESP) was examined, as well as ways to improve the mathematical equations used to analytically described IC curves. A field infiltrometer was designed and constructed for field studies; a method incorporating the initial moisture in the profile (antecedent moisture) was developed due to field study difficulties. As an alternative to field study, IC curves were determined on undisturbed soil cores of varying salinity and 2-year irrigation treatment, planted to alfalfa. Study of the curves indicated that there is a continuous effect caused by increasing the Na adsorption ratio from 7.5-30. Watering with high EC water apparently reduces the Na dispersion, an argument having ramifications in sub-humid areas where over half the watering occurs with rainfall of low EC. Analytical study of the mathematical equations describing IC curves indicated that no universal analytical procedure can presently provide consistent estimates of the infiltration characteristics of moist soil over wide soil moisture and cover conditions. (Zielinski-MAXIMA)
W82-06712

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,
Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 2G.
W82-06856

3D. Conservation In Domestic and Municipal Use

WATER CONSERVATION INCENTIVES AND STRATEGY,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243312, Price codes: A04 in paper copy, A01 in microfiche. Report, October 1981. 53 p, 4 Tab, 7 Fig, 69 Ref. OWRT C-90184-C(1), 14-34-0001-9454.

Descriptors: *Water conservation, *Economics, *Water policy, *Drought, Water quantity, Water analysis, Water availability, Water control, Water deficit, Water loss, Water management, Water rates, Water reuse, Water shortage, Groundwater mining, *Renewable resources, *Drought contingency plans.

In 1976, President Carter announced that water conservation would be the cornerstone of his water policy, defining the term to mean reducing inefficiency, wastage and unnecessary usage (and excluding the aspect of 'conserving' water by storing it for future use). Water conservation thus defined has become a popular goal, sometimes advocated with a fervor bordering on the religious. New Jersey,in formulating a Statewide Water Supply Master Plan, has had to deal with water conservation along with economic objectives and engineering methodology. Analysis of the economic theory of Water Resources Development and Planning has been applied to evaluate various policies and issues. This analysis indicates that water conservation has been a slogan rather than a coherent program, that following it as a goal may sometimes be counter productive, and that there is often confusion between a conservation 'ethic' which is an end in itself, and conservation as a means of obtaining various economic objectives. Analysis indicates that outside of groundwater 'mining', water is usually a renewable and reusable resource. During periods of normal precipitation, water conservation should be employed only when the value of the water saved exceeds the cost of affecting the savings. Water conservation is most valuable as a drought contingency tactic. Water conservation as a substitute for structural provision to meet normal water needs is apt to prove shortsighted. (Author abstract)
W82-05906

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,
California Univ., Los Angeles.
E. A. Engelbert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243460, Price codes: A04 in paper copy, A01 in microfiche. Report, August 1978. 48 p, 26 Ref. OWRT (8571)(1).

Descriptors: *Water conservation, *Institutional constraints, *Environmental effects, *Economic aspects, *Decision making, Institutions, Legal aspects, Public participation, Attitudes, Social participation, Regulations, Equitable apportionment, Water law, Water policy, Public policy, Organizations, Federal jurisdiction, Political constraints.

Ten aspects related to incentives and institutions for water conservation are separtely addressed, with general observations and research/action objectives discussed for each. These aspects include: available literature; water conservation concepts (changing perceptions; water needs); public knowledge and awareness (information gaps; cultural patterns/beliefs; education/communication); ethical/equity considerations (individual/group equity; community welfare); environmental aesthetic considerations (environmental water conservation as an integrative-systems process); social/political considerations (community living patterns and life styles; dynamics of social decision-making; the participatory process for citizens in water policy formulation); economic considerations (the pricing system; taxes/subsidies and other financial incentives); water policies (lack of a national conservation policy; integrating water supply and water quality policies and programs; conjunctive management for surface/ground waters; water reclamation/reuse); law and regulations (legal relationships modification; administrative flexibility enhancement; legal conservation incentives); and organizations and administrative arrangements (organizational pluralism/integration; federal-state relationships; political decision-making; bureaucratic attitudes/committments). (Zielinski-MAXIMA)
W82-05922

LEAK LOCATION ENTERS COMPUTER AGE,
New York City Dept. of Environmental Protection, Bureau of Water Supply.
For primary bibliographic entry see Field 7A.
W82-06018

THE IMPACT OF MASS DISTRIBUTION OF WATER CONSERVATION DEVICES AND A WATER CONSERVATION RATE STRUCTURE ON RESIDENTIAL WATER USE,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
W. E. Sharpe, C. E. Young, and K. R. Kinsley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243700, Price codes: A04 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, Report, April 1982. 49 p, 5 Fig, 12 Tab, 25 Ref, 1 Append. OWRT B-112-PA(1), 14-34-001-9092.

Descriptors: *Surveys, *Water rates, *Water use efficiency, *Water users, *User charges, Water use, Water demand, *Water conservation, Urban areas, Water distribution, Water costs, Evaluation, Competing use, Consumptive use, Reasonable use, Conservation, Water supply, Economic aspects, Water control, District of Columbia, Maryland, *Washington Suburban Sanitary Commission.

A study of 545 residential customers of the Washington Suburban Sanitary Commission in the suburban Washington, DC area was undertaken to determine the impacts of mass water conservation device distribution and a water conservation water rate on their long-term water demand. An econometric model was used to assess the impact of the water conservation rate. The study showed a 17% decline in the quantity of water use over the 1974-79 study period. The majority of customers reported changing their habits to use less water; 42% also reported installing water conservation devices. The model output showed a greater decline in water use after the water conservation rate was implemented. High water users reduced their water demand most in response to the rate change. The water conservation rate appeared to increase the use of water conservation devices, and to stimulate greater water use habit modification. Most customers (51%) had no opinion when asked whether they liked/disliked the water conservation rate policy; however, given the choice between decreasing/increasing/uniform rate schedules, only 10% of the residential customers responding preferred the decreasing type of rate schedule. (Zielinski-MAXIMA)
W82-06155

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,
Stanley Consultants, Inc., Muscatine, IA.
For primary bibliographic entry see Field 6C.
W82-06222

WATER RATES AND RESIDENTIAL WATER CONSERVATION,
National Bureau of Standards, Washington, DC.
B. C. Lippiatt, and S. F. Weber.
Journal of the American Water Works Association, Vol 74, No 6, p 278-281, June, 1982. 4 Tab, 14 Ref.

Descriptors: *Water conservation, *Pricing, Water rates, Domestic water, Water users, Economic aspects, Conservation.

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The five major types of water rate schedules are explained and discussed in terms of their conservation incentives. Then the rate schedules of a national sample of 90 water utilities are analyzed. Sample means are calculated for selected rate schedule variables, including the correct price for valuing a unit of conserved water and the average price of water. The results indicate that when estimated bill reductions are based on average price, overinvestment in water conservation is likely to result. In addition, the significant price variation found in the results highlights the importance of using local rate schedules, rather than national averages, to value conserved water. (Baker-FRC)
W82-06276

COST-BASED WATER RATE DESIGN,
Norville (Rodney L.) and Co., Houston, TX.
For primary bibliographic entry see Field 6C.
W82-06277

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,
Florida Univ., Gainesville. Dept. of Food and Resources Economics.
For primary bibliographic entry see Field 6C.
W82-06351

POLICING DEMAND THROUGH PRICING,
Fairfax County Water Authority, Merrifield, VA.
For primary bibliographic entry see Field 6D.
W82-06352

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,
Policy Sciences Associates, Boulder, CO.
W. B. Lord, J. A. Chase, and L. A. Winterfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256686, Price codes: A04 in paper copy, A01 in microfiche. Research Report 82-1, January 28, 1982. 58 p, 13 Tab, 3 Fig, 24 Ref, 1 Append. OWRT C-90123-C(1), 14-34-0001-0530.

Descriptors: *Water conservation, *Municipal water, *Water demand, *Evaluation, Attitudes, Behavior, Elasticity of demand, Lawns, Pricing, Rationing(Water), Social values, Alternative regulatory mechanisms, Public acceptability.

A study of public acceptability and potential water use response to a variety of municipal water conservation policy options was conducted in three Colorado Front Range communities in the 10,000 to 100,000 population range. The study was focused upon water used for lawn watering, because it accounts for nearly half of total residential water use and for a much greater share of both consumptive water use and water system peak load requirements. Policies which provided water conservation information were the most acceptable. Policies which rewarded people who took conservation actions and some policies which included restrictions on water use were acceptable to most. Penalties and restrictions perceived to be inequitable or severe were unacceptable. Conservation pricing was moderately acceptable and was one of the more effective policies in achieving water use reductions. Most respondents preferred increasing or inverted block pricing to the more common declining block pricing policy. Public information would be a desirable component of any municipal water conservation program. Conservation pricing deserves prime consideration for a utility emphasizing either effectiveness or financial feasibility. A utility emphasizing acceptability will face a difficult choice, because there tends to be an inverse relationships between acceptability and effectiveness. (Author abstract)
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,
Nevada Univ. System, Reno. Desert Research Inst.
J. W. Fordham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256793, Price codes: A04 in paper copy, A01 in microfiche. Publication No 41073, April, 1982. 58 p, 9 Fig, 18 Tab, 37 Ref. OWRT A-095-NEV(1).

Descriptors: *Water use, *Mathematical models, *Projections, *Hydrologic budget, *Competing use, Computer models, Mathematical studies, Model studies, Forecasting, Prediction, Water availability, Induced infiltration, Water requirements, Alternative water use, Groundwater recharge, Urbanization, *Nevada, Truckee Meadows.

Water use changes during the past decade and water use projections to the year 2000 are described for the truckee Meadows valley, which hosts one of the fastest growing metropolitan areas in the U.S. (Reno/Sparks). Identified and quantified are: the added urban use in previously undeveloped areas; the water need changes for areas transformed from agriculture to urban; the reduction in induced groundwater recharge to the Truckee Meadows. A simplified water balance model which incorporated inflow of tributary streams, average river flows, precipitation, and temperatures was used to develop current and projected water budgets, providing a balance by diverting waters by source, river, tributary, or groundwater, and accounting for losses and returns to the river system. The projected total diversion for the Meadows from surface sources in the year 2000 (132,000 acre-feet/year) remains below total water rights currently allocated. Induced recharge is projected to decline (by about 25%) by 5040 acre-feet/year due to urbanization. Urban runoff is projected to increase about 4350 acre-feet/year for the same reason. The results depict a water balance for the Meadows at the current area development rate, since growth rate and land use change have slowed significantly since 1979. The net difference between inflow and outflow is equal to the total annual loss expected under each level of development. (Zielinski-MAXIMA)
W82-06705

COUNTY PROVIDES A RURAL WATER SUPPLY SYSTEM,
URS Engineers, Seattle, WA.
W. L. Berschauer, and N. Miller.
Public Works, Vol 113, No 7, p 63-65, July, 1982.

Descriptors: *Public utility districts, *Political aspects, *Water supply, Water distribution, Municipal water, Gardiner, *Washington, Jefferson County, Utilities.

The 200 residents of Gardiner, Washington, lacking sufficient groundwater supplies, petitioned the Jefferson County Public Utility District (PUD) 1 in 1976 to investigate the feasibility of a community water system. After a test well located a large aquifer with excellent water quality, the Farmers Home Administration agreed to finance the project with a $1 million loan. After a public hearing in November 1979, Local Utility District No. 1 was established. The system, comprising 7 miles of distribution main, two concrete storage tanks, two pressure reducing stations, a booster pump station, and a well pumping station, was placed in service in August 1981. The PUD is currently studying other requests for similar water systems in its jurisdiction. (Cassar-FRC)
W82-06843

3E. Conservation In Industry

REORGANIZATION OF GROUNDWATER UTILIZATION SOUGHT (NEUORDNUNG DER GRUNDWASSERVERWENDUNG ANGESTREBT),
H. Keune.
Wasser, Luft and Betrieb, Vol 26, No 1/2, p 14-16, 1982. 1 Tab, 15 Ref. (No English summary).

Descriptors: *Groundwater management, *Industrial water, *Water districts, *Water law, Water supply, Water scarcity, Surface water, Costs, Water conveyance, Economic aspects, Administrative regulations, Public policy, Federal Republic of Germany.

The 1981 'water crisis' in the Federal Republic of Germany precipitated efforts to reduce industrial consumption of groundwater. While this actually decreased between 1975 and 1977, some statistics did not reflect this, because recharged groundwater and bank filtrate were counted as surface water by the public water authorities, but as groundwater by industry. The fact that industrial demand is significantly less than public demand and that only in certain regions is there competition for the groundwater supply means that this issue can be resolved locally. The suggestion that industry release water from its wells to the public supply in exchange for nonpotable water at no cost to either party is impractical due to lack of suitable water and pipelines, administrative difficulties, and costs. The suggestion that industry be permitted to use groundwater only when this comes from the public supply is also impractical, as chlorinated or otherwise disinfected water is not always suitable for industrial use. Rationing plans are not likely to be instituted in the foreseeable future due to technical difficulties. The only remaining option is conventional water law, which can provide restrictions on the issuing of permits and concessions for groundwater use. (Gish-FRC)
W82-06022

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6D.
W82-06160

WASTE-HEAT VERTICAL TUBE FOAM EVAPORATION FOR COOLING TOWER BLOWDOWN RENOVATION/RECYCLE,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton, and K. Someahsaraii.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256629, Price codes: A07 in paper copy, A01 in microfiche. Report, February, 1982. 114 p, 32 Fig, 9 Tab, 22 Ref. OWRT C-90052D(0427)(1).

Descriptors: *Cooling towers, *Power plants, *Heat transfer, *Waste heat, *Water reuse, Cooling water, Industrial water, Heat exchangers, Heat, Water use, Reclaimed water, Industrial plants, Thermal water, Heated water, Environmental engineering, Engineering, Energy loss.

A prototype waste-heat vertical tube foam evaporation (WH-VTFE) plant was designed, constructed, and field-tested for reducing power plant cooling tower blowdown to a small residual volume of solids slurried in brine, while producing distilled water for reuse. Facility design was based on previously-developed pilot plant test data. The WH-VTFE facility was constructed for initial parametric testing in demonstration phase was conducted at a power plant site using turbine exhaust steam for the up to 50-fold cooling tower blowdown concentration in a foamy-flow seed-slurried mode of downflow vertical tube evaporation. The VTFE heat transfer coefficient ranged between 5600-9000 W/sq m/degree, a sufficient temperature difference is available within a typical power plant heat rejection system to operate a WH-VTFE when the plant load is above 50% of its design capacity. Scale formed from inadequate brine recycle rates was readily removed by recycling fresh water through the evaporator to restore the high heat transfer performance of the WH-VTFE. It was concluded that WH-VTFE was demonstrated as feasible and commerically viable. (Zielinski-MAXIMA)
W82-06369

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,
Energy Policy Studies, Inc., Omaha, NE.
M. W. Gilliland, and L. B. Fenner.
Resources and Conservation, Vol 6, No 3/4, p 167-185, 1981. 5 Fig, 4 Tab, 18 Footnotes.

Descriptors: *Water conservation, *Energy, *Agriculture, *Water management(Applied), Irrigation efficiency, Canal linings, Cooling water, Electric power industry, San Juan River, *New Mexico, Colorado River Basin, Coal mining, Gasification, Water requirements.

Impacts of five water management options and non-management are described for the San Juan County, New Mexico, region in the Upper Colorado River Basin. The five strategies chosen for evaluation are canal lining, canal lining with sprinkler irrigation, all dry cooling of energy producing plants, combination wet/dry cooling of energy producing plants, and reuse of uranium mining discharge water as cooling water for gasification plants. Results of evaluating water quantity, instream flows, and water quality showed that improved agricultural irrigation efficiencies and dry cooling in the energy industry will have little effect on water quantity and quality over the next 20-25 years. In the San Juan River, water flow at Shiprock will decrease from 56,200 liters per sec at present to 35,300 liters per sec with no management. Conservation measures are expected to produce flows of 35,700-38,300 liters per sec. During 1 to 3 months of the year, flows will be insufficient to maintain good instream conditions, depending on the water management strategy used vs. 3 months with no management. Likewise, salinity at three stations will increase by 17% with no management and slightly less with the management options studied. Overall, dry cooling in the energy industry would reduce projected water depletion by 10%, salinity by 2%, and instream impacts by 8%. The agricultural conservation measures would not change water depletion, and would reduce projected salinity increases by 5% and instream impacts by 4%. The minor improvements are cost effective for the energy industry but not for agriculture. (Cassar-FRC)
W82-06517

3F. Conservation In Agriculture

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6B.
W82-05909

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 3C.
W82-05920

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W82-05921

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
S. Kim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243486, Price codes: A07 in paper copy, A01 in microfiche. Report, September 1981. 122 p, 21 Fig, 16 Tab, 49 Ref, 5 Append. OWRT B-041-IDA(4). 14-34-0001-8079.

Descriptors: *Irrigation practices, *Flow discharge, *Prediction, *Irrigation requirements, *Time series analysis, Irrigation districts, Irrigation water, Influent water, Water use, Model studies, Forecasting, Projections, Water use efficiency, Model testing, Statistical methods, Mathematical studies, Computer programs, Evapotranspiration, *Idaho.

Daily water flow data from two large irrigation districts in the Upper Snake River over three irrigation seasons (1978-1980) were analyzed and methodology was investigated for the predictions of daily water diversions. Crop consumptive water use, estimated by the combination method on a daily basis, varied greatly on a daily basis, and its pattern was quite different from year-to-year. In addition, seasonal irrigation use levels were different for different years for the districts, while seasonal water use patterns were similar for the different years and districts. Fluctuations, and relations among inflow, outflow, evapotranspiration, and precipitation were assessed using graphical and statistical methods. A slight change in evapotranspiration was found to cause a rather large change in inflow. A weekly cycle was found to exist within outflows, but no significant frequency was found within inflows. Time and diversion interrelationships were established, and, based on the time effects, proper consumptive irrigation requirements were estimated at the district level. The methodology developed for predicting water diversions took the form of a computer program, and was observed to provide reasonable predictions for the study area. (Zielinski-MAXIMA)
W82-05924

CABLEGATION: II. SIMULATION AND DESIGN OF THE MOVING-PLUG GATED PIPE IRRIGATION SYSTEM,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid, and W. D. Kemper.
Transactions of the ASAE, Vol 25, No 2, p 388-395, March/April, 1982. 13 Fig, 1 Tab, 12 Ref.

Descriptors: *Cablegation, *Irrigation design, *Pipe flow, Furrow irrigation, Infiltration, Automation, Orifice flow.

The cablegation irrigation system consists of a surface pipe, laid on a slope at the head end of a field, which serves as both the conveyance and distribution pipe. Gates or holes near the top of the pipe are left open. Water is introduced at a flow rate less than the free surface flow capacity of the pipe. A plug, restrained by a cable, is allowed to move down the pipe at a slow rate, causing water to flow out of the holes upstream from the plug, and thus moving the entire flow across the field. This paper develops a simulation model to predict the time distribution of orifice flow, the distribution of infiltrated water across a field, and runoff rates. The model is usable for designing cablegation systems for fields with variable pipe slopes and variable furrow lengths. To obtain the optimum net water application and keep furrow stream sizes within acceptable limits the orifice size along the pipeline and the plug travel speed are varied. The system has been successfully operated at pipe slopes between 0.0026 and 0.022. It is especially well suited to cases where the furrow width is narrow relative to the total width of the field. (Cassar-FRC)
W82-05963

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
W. D. Kemper, B. J. Ruffing, and J. A. Bondurant.
Transactions of the ASAE, Vol 25, No 2 p 333-339, 343, March/April, 1982. 7 Fig. 2 Tab. 15 Ref.

Descriptors: *Irrigation practices, *Infiltration rate, *Compacted soils, *Furrow irrigation, Water management, Soil compaction, Sprinkler irrigation, Soil properties, Water temperature.

Many farmers have abandoned the energy-intensive sprinkler irrigation method in favor of a return to furrow irrigation. One problem with furrow irrigation is decreased crop yields caused by nonuniform water distribution. A study of furrow intake rates produced several suggestions for improving uniformity of water distribution. Intake uniformity can be improved by restricting tractor traffic to tracks that are not used for irrigation, compacting corrugates in which water will run so that the soil on the perimeter has a lower infiltration rate than the rest of the soil, reducing flow rate, using longer runs and smaller pipe sizes, compacting soil in selected areas, applying straw to furrows where increased infiltration is desired, and decreasing the slope at the lower ends of the fields. (Cassar-FRC)
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliot, and W. R. Walker.
Transactions of the ASAE, Vol 25, No 2, p 396-400,March/April, 1982. 4 Tab, 8 Ref.

Descriptors: *Infiltration, *Irrigation, *Furrow irrigation, *Colorado, Advance functions, Kostiakov-Lewis function, Soil properties, Volume balance method, Field tests, Soil water, Mathematical equations.

Furrow infiltration and advance functions were evaluated in three Colorado farm soils (clay loam, loamy soil, and loam to clay loam). Lengths of irrigated runs were 350-625 m and furrow slopes 0.25-1%. Data were used to study infiltration and advance relations based on a kinematic or volume balance approach. The Kostiakov-Lewis function modified by a term for the asymptotic long time infiltration rate was highly effective in simulating infiltrated volumes when reliable estimates of the steady infiltration rate could be obtained. The power curve form of the advance function was better fitted using the two-point method than using regression. (Cassar-FRC)
W82-05969

IRRIGATION REQUIREMENT OF HIGH-YIELDING RICE VARIETIES GROWN ON SOILS HAVING SHALLOW WATER-TABLE,
Central Rice Research Inst., Cuttack (India).
K. P. Jha, D. Chandra, and Challaiah.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 732-737, October, 1981. 5 Tab, 10 Ref.

Descriptors: *Irrigation requirements, *Rice, *Water use efficiency, *India, Water table, Grain crops, Crop yield.

High-yield rice varieties under limited irrigation produced grain yields comparable to rice grown under continuous or partial flooding of fields. The study, conducted during the winters of 1976-78 in sandy loam alluvial soil with a winter water table depth of 35-52 cm, used four irrigation treatments: I1, continuous flooding; I2, irrigation (7 cm) at moist conditions, 2-3 days after disappearance of ponded water from the field; I3, flooding at tillering and flowering but irrigation at moist conditions at other stages; and I4, irrigation (7 cm) at 30-35 mm of cumulative pan evaporation. Treatment I1 required 1403-1600 mm irrigation water, I2, 887-910 mm; I3, 1073-1097; and I4, 793-840 mm. Water use efficiencies were: I1, 2.48-2.97; I2, 4.17-4.42; I3, 3.26-3.77; and I4, 3.84-5.27 kg grain/mm water. The short duration Pusa variety (114 days) had higher water use efficiency than the other varieties, Supriya (132 days) and Vani (143 days). (Cassar-FRC)
W82-05971

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
For primary bibliographic entry see Field 2I.
W82-05972

THE EFFECT OF SHORT-TERM WATERLOGGING DURING FURROW IRRIGATION OF COTTON IN A CRACKING GREY CLAY,
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station
A. S. Hodgson, and K. Y. Chan.
Australian Journal of Agricultural Research, Vol 33, No 1, p 109-116, 1982. 2 Fig, 4 Tab, 14 Ref.

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Descriptors: *Irrigation, *Cotton, Crop yield, Crop production, *Waterlogging, Irrigation practices, Agriculture, *Furrow irrigation.

The effects of waterlogging on plant and soil were studied by subjecting cotton to periods of inundation at successive irrigations ranging from 4 to 16 hours in a cracking grey clay. The growing season was hot and dry and effects of waterlogging were not aggravated by rainfall or excessively overcast conditions. Plant growth was virgorous and visual symptoms of waterlogging were limited to a low section of the field where plant leaves became chlorotic in late February and prematurely senesced. Similar symptoms were noted for cotton which was waterlogged during flowering and boll setting in other reports from northern Australia valleys. Waterlogging treatment in this experiment had little effect on leaf area index, dry matter per square meter and plant height. In most cases the 8, 12, or 16 hour treatment effects were not significantly different. Any existing differences were reflected in final lint yields, where the 4 hr treatment yields were significantly higher than the 12 and 16 hr yields, and the 8, 12, and 16 hr yields were not significantly different. It was concluded that lint yield is likely to increase if cotton crops are irrigated and drained faster to reduce contact time. The farmer may achieve this by using larger siphons, more siphons per furrow, shorter fields or steeper slopes. (Baker-FRC)
W82-06010

THE EFFECT OF ELECTRICITY PRICES, LIFT, AND DISTANCE ON IRRIGATION DEVELOPMENT IN IDAHO,
Idaho Univ., Moscow.
J. R. Hamilton, G. S. Barranco, and D. J. Walker.
American Journal of Agricultural Economics, Vol 64, No 2, p 280-285, May, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation, Model studies, *Irrigation practices, Crop yield, *Idaho, Economic aspects, Agriculture, Crop production, Prices.

Parametric budgeting was used to simulate the impacts of variations in farm size, crop prices, crop yields, electricity rates, lift height, and distance from the river on the private economic feasibility criterion currently being used by the US Bureau of Land Management. Maximum feasible lift heights and carry distances are identified, and developable acreage through irrigation programs is estimated. An obvious limitation of the parametric budgeting procedure used is its omission of financial tax incentives which may accrue to some operators. The model is also limited by its partial equilibrium nature. Management options such as irrigation system alternatives or crop changes in response to higher electricity prices were not considered. Results of the study indicate that per acre returns on irrigated tracts increase slightly with farm size. Under base conditions all farm sizes examined could sustain nearly a 10% decline in crop price or yields. Given the base lift, 550 feet, and the base distance, 5 miles, all farm sizes considered could sustain a 100% increase in electric rates. However, with a 200% power rate increase, irrigation feasibility would be limited to the largest farms with lifts less than 550 feet and distances less than 4 miles. Of the lands in the BLM study area, all but the highest and most distant could be developed under base yields, prices, and power rates. However, plausible increases in power rates could limit development to low lift land near the river, sharply reducing the total feasible acreage. The criteria being used by the BLM would permit development of more land than meets social criteria but not enough to meet private demands. (Baker-FRC)
W82-06017

MOISTURE CONSERVATION OF INTERSEEDED GRASSLANDS THROUGH THE USE OF ANNUAL AND PERENNIAL CROP BARRIERS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
F. R. Vigil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243635, Price codes: A04 in paper copy, A01 in microfiche. South Dakota Water Resources Institute, Brookings, Report, December 1981. 53 p, 17 Tab, 11 Ref, 4 Append. OWRT A-069-SDAK(1), 14-34-0001-9044.

Descriptors: *Soil moisture deficiency, *Grasslands, *Standing crops, *Alfalfa, Moisture content, Moisture stress, Seed treatment, Seeds, Snow management, Soil water, Barriers, Crop production, Wheatgrasses, Sorghum, Planting management, Drilling equipment.

Interseeding, a method of introducing alfalfa into the range with only a partial disturbance of the existing vegetation, is used to improve forage resources in South Dakota. Since moisture was considered as the principal factor in determining whether a stand would succeed or fail, perennial (Tall wheatgrass) and annual (sorghum and sunflowers) crop barriers were planted on native ranges from 1978-81 in an effort to conserve moisture through snow retention. These barriers failed to establish in all four years, which may be due in large part to fungalnematode interactions. Large areas in the State were discovered to be having difficulty in establishing legumes, even under irrigation. Fungicide seed and soil treatment, nematicides, and biological control methods for controlling damping-off disease (caused by Pythium spp. and nematodes) were tested for alfalfa stand establishment. Other causes for failure of establishing annual/perennial crop barriers into a growing grass sod are suggested. A newly-developed drill for interseeding into semi-arid rocky environments is reported. (Zielinski-MAXIMA)
W82-06148

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-06156

SPRINKLER LEVELER AND WIND COMPENSATING DEVICE,
Wade (R. M.) and Co., Portland, OR.
G. Cornelius.
U.S. Patent No 4,204,643, 8 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1261, May 27, 1980.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A main irrigation pipe with wheels has mounted along its length movable sprinkler heads. Each sprinkler head has a flat, bladelike member, the weight of which aids in urging that sprinkler head toward an erect position. Meanwhile the bladelike member compensates for wind by leaning the sprinkler head into the wind to provide a more even distribution of water. (Sinha-OEIS)
W82-06164

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 2G.
W82-06172

EFFECT OF IRRIGATION FREQUENCY AND NITROGEN ON GROUNDNUT YIELD AND NUTRIENT UPTAKE,
Andhra Pradesh Agricultural Univ. (India). Dept. of Agronomy.
S. R. Reddy, P. S. Chalam, G. H. S. Reddi, and A P. Raju.
Plant and Soil, Vol 65, No 2, p 257-263 1982. 2 Tab, 13 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Groundnuts, *Potassium, *Nitrogen, Nutrients, Phosphorus, Soil moisture, Moisture availability.

Field experiments were conducted during the summers of 1979 and 1980 to study the effect of irrigation frequency and levels of nitrogen on yield and uptake of the major nutrients by Spanish groundnut. The soil was sandy loam, with a low moisture retentive capacity, low in available nitrogen and low in available potassium. The soil was moderately alkaline in reaction with a pH of 8.3. Four irrigation frequencies were used during the study, including irrigation at 1,4,6, and 8 cm cumulative can evaporation (CCE) corresponding to irrigation once in 3,5,7, and 10 days, respectively. Four levels of nitrogen were also used, 0,20,40 and 60 kg N/ha. Nitrogen, phosphorus (35 Kg P/ha) and potasssium (60 kg K/ha) were applied in the form of urea, single superphosphate and potash, respectively. Pod yield of groundnut was highest at 3,293 kg/ha when irrigations were scheduled at 4 cm cumulative can evaporation, equivalent to once every 5 days. The addition of N did not increase pod yield. N and P uptake by the crop was greatest with high frequency of irrigation of scheduling irrigation at 4 cm CCE. The highest uptake of N and P was with a combination of 20 kg N/ha and high frequency irrigation. Potassium uptake was low with low irrigation frequency, while it was highest at 20 kg N/ha. (Baker-FRC)
W82-06230

DESIGNING FOR DEFICIT IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, and G. S. Nuss.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 91-106, June, 1982. 2 Fig, 8 Tab, 8 Ref. OWRT 14-31-0001-2139.

Descriptors: *Irrigation practices, *Irrigation design, *Deficit irrigation, Wheat, Oregon, Water conservation, Economic analysis, Crop yield, Cost analysis, Evapotranspiration, Energy, Capital costs, Benefits.

Two irrigation systems, one for full irrigation and one for deficit irrigation, were designed for a farm in eastern Oregon growing winter wheat. A comparison of costs and performances for the two systems showed that deficit irrigation increased farm income and reduced energy, water, and capital requirements. The full irrigation system schedule was two sets per day (11 hours each set), 2.3 inches gross water applied per set, 32 inches gross water applied per season, and a 6 day minimum interval between irrigations. The root zone would not be depleted by more than 50% between irrigations. The deficit irrigation scheme specified soil moisture depletion in excess of 50% of available water during times of peak demand. The irrigation schedule was two sets per day (11 hours each set), 3.15 inches gross water applied per set, 20 inches gross water applied per season, and a 12 day minimum interval between irrigations. Using the water saved by deficit irrigation allowed the 92 acre plot to be extended to 143 acres, increasing net farm income by 42%. The amounts of benefits from deficit irrigation are dependent on system design and many other factors. Each case must be completely analyzed individually to determine the merits of deficit irrigation. (Cassar-FRC)
W82-06334

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,
Texas Water Resources Inst. College Station.
D. Lacewell, C. Hardin, J. A. Petty, and E. Whitson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256678, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 119, May, 1982. 52 p, 16 Tab, 1 Fig, 26 Ref. OWRT A-045-TEX(3). 14-34-0001-9046, 0146, and 1146.

Descriptors: *Irrigation, Water efficiency, Economics, *Texas High Plains, Texas Trans-Pecos,

Ogallala, Economic impact, Model studies, Linear programming.

Resursive linear programming models for a typical Texas High Plains irrigated farm were developed to evaluate expected impact of energy and crop price changes, tenure and new technology. The model includes a Fortran sub-routine that adjusts irrigation factors each year based on the linear programming solution of the previous year. Increased natural gas prices impact heavily on returns above variable costs (up to 15 percent reduction for a 60 percent natural gas price increase). Annual net returns were reduced by as much as 30 percent, and the present value of returns to water was reduced by as much as 80 percent as the natural gas price was increased annualy by $0.25 per mcf (from $1.50 per mcf). Increasing pump efficiency from 50 to 75 percent can improve farm profits over time; e.g., the present value of groundwater was increased 33 percent for a typical farm with an aquifer containing 250 feet of saturated thickness and 15 percent for 75 feet of saturated thickness. Results indicate that irrigation can be extended by 11 or more years with 50 percent improved distribution efficiency. In addition, the increase in present value of groundwater on the 1.69 million irrigated acres of the Texas High Plains was estimated to be $995 million with 50 percent improved efficiency. Wind assisted irrigation pumping could be an economically viable alternative if costs decrease and stabilize. The results are limited by uncertainties of the long-term characteristics of wind system operation.
W82-06374

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1.
Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1082 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigatiion, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This first volume of a 2-volume textbook set covers 7 topic areas concerning engineering aspects of irrigated lands. Following a general introduction covering human, social, economic, administrative, financial, and technical aspects, detailed attention is given to hydrologic and hydraulic topics related to irrigated land. Specific topics address the areas of: meteorology and climatology; surface hydrology; hydraulics and hydrology of underground waters; use of underground waters; evaluation and classification of soils; and farming and irrigated land. Meteorologic/climatologic aspects include specifics on solar radiation, precipitation, drought, and erosion. Surface hydrology materials includes deep valley characteristics, laws of distribution, copious water, flooding, and calculation methods. Underground water topics include hydraulics and movement, water balance, methods of variation, water quality and analysis, and recovery systems. The discussion on soils includes chemical composition, reactions, erosion characteristics and modeling, and sedimentation. Farming aspects cover farming and climate, and limitations in the choice of proper surface farming. Twelve additional topic areas covering engineering aspects of irrigated lands are covered in Volume 2. (Zielinski-MAXIMA)
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,
Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1236 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigation, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This second volume of a 2-volume textbook set covers 12 topic areas concerning engineering aspects of irrigated lands. Specifically, these topic areas address: equipment and methods of irrigation; networks of irrigation by gravity networks of irrigation by pressure; practical methods of investigation of irrigated canals; agricultural drainage; road networks; electrical limits; grading of lands; agricultural and hydraulic development; economic feasibility; organization and legislation; and a model of agrarian planning. A detailed annotated list of definitions of hydroagronomy terms is also included. Seven additional topic areas concerning engineering aspects of irrigated lands are covered in Volume 1. (Zielinski-MAXIMA)
W82-06376

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 18, No IR2, p 127-141, June, 1982. 10 Fig, 8 Ref.

Descriptors: *Irrigation design, *Basin irrigation, Infiltration, Design criteria, Mathematical equations, Gravity flow, Soil classification.

A previous method for designing level irrigation basins is extended to cover a wider range of infiltration conditions. The limit of the basin length is determined. It depends on application depth, infiltration conditions, roughness, and the desired uniformity. A 6-step procedure for designing level basins is detailed and an example given for alfalfa on a silt loam with moderate infiltration rate. The steps are as follows: (1) determine design conditions (uniformity, net infiltration depth, time required to infiltrate net depth, exponent of infiltration function, and roughness from 004 for bare soil to 0.25 for dense sod crops): (2) calculate reference values for basin length and unit flow rate; (3) determine approximate limit on basin length; (4) determine a value for basin width; (5) determine application time (equations are given for uniform or irregular basins); and (6) consider other limitations such as soil variability, practical considerations of field dimensions, and surface roughness of the field. Design conditions should be evaluated for different types of crops and for different conditions throughout the growing season. (Cassar-FRC)
W82-06452

RESPONSES OF 6-YEAR-OLD DIAMOND GRAPEVINES TO THE CHANGE FROM SPRINKLER TO TRICKLE IRRIGATION AND TO THE TIME AND METHOD OF APPLYING NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Journal of Soil Science, Vol 61, No 4, p 571-575, November, 1981. 4 Tab, 7 Ref.

Descriptors: *Nitrogen, *Trickle irrigation, *Crop yield, *Sprinkler irrigation, Irrigation effects, Irrigation practices, Fruit crops, Fertilizers, *Grapevines, *Pacific Northwest U.S.

Little research has been conducted on the performance of grapevines under trickle irrigation in the Pacific Northwest, where wine grapes have become an important crop. A vineyard which had received regular cyclical sprinkler irrigation for the first 6 years of its existence was changed to trickle irrigation to determine how well the mature vines would adapt to the point-source method of irrigation. Water application was reduced by about 20% under trickle irrigation. The Diamond grape yield was measured for 3 years, after which nitrogen fertilizer tests were conducted for 3 years to determine whether significant changes in the fertilizer program were needed with trickle irrigation. The change from sprinkler to trickle irrigation caused no detectable growth or yield changes of the grapevines or fruit. Fertilizer tests under trickle irrigation demonstrated no significant Diamond grape yield differences between fall and spring broadcast nitrogen fertilizer or between either of those treatments and spot placement of nitrogen under trickle emitters in two of three seasons. None of the treatments had any effect on soluble solids or the titratable acidity of the grape berries or on the percent petiole nitrogen. (Carroll-FRC)
W82-06492

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,
Energy Policy Studies, Inc., Omaha, NE.
For primary bibliographic entry see Field 3E.
W82-06517

AUTOMATION OF A SPRINKLER IRRIGATION SYSTEM BY THE UTILIZATION OF REAL TIME WEATHER INFORMATION,
Nebraska Univ. Panhandle Station at Scottsbluff.
A. Weiss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256710, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center, Lincoln. June 1982. 39 p, 4 Fig, 1 Tab, 39 Ref. OWRT A-064-NEB(1), 14-34-0001-1129.

Descriptors: *Sprinkler irrigation, *Mathematical equations, *Evapotranspiration, *Crop yield, *Weather data collections, *Automation, Irrigation, Evapotranspiration control, Irritation efficiency, Irrigation engineering, Irrigation practices, Irrigation design, Irrigation water, Soil water, Soil moisture deficiency, Farming, Weather patterns.

A method is described for quantitatively calculating reference crop evapotranspiration (ET), based on sound physical principles with a minimum of empiricisms. The method uses the Doorenbos and Pruitt version of the Penman equation for ET calculation. Using refeence crop ET as an input, the actual crop ET, acutal and percentage soil water depletion are determined using crop coefficient curves based on growing degree days. This approach to irrigation scheduling was used in conjunction with an automated weather station to schedule irrigation of two fields of dry edible beans grown under center pivot systems. Yields obtained from both fields were above-average, compared to the average yield for the region. However, actual automation of an irrigation system was not accomplished due to reluctance of the cooperative farmer allied to the study in permitting independent automated control of his center pivot irrigation system. While irrigation scheduling information is a valuable tool to the farmer, he desires to reserve the right to decide when to irrigate. Nonetheless, the procedural information developed in this study can assist the use of networks of automated weather stations to provide information on irrigation scheduling on a regional basis. (Zielinski-MAXIMA)
W82-06695

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W82-06712

COMPUTER SIMULATION OF SURFACE IRRIGATION BY MEANS OF NUMERICAL METHODS FOR FINDING OPTIMAL PARAMETERS,
Vsesoyuznyi Naucho-Issledovatelskii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
R. M. Kiladze.
Water Resources, Vol 8, No 3, p 312-318, May/June, 1981. 2 Fig, 3 Tab, 23 Ref. Translated from Vodnye Resursy, N0 3, p 146-153, May/June, 1981.

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Descriptors: *Irrigation efficiency, *Numerical analysis, *Optimization, Computers, Surface irrigation, Border irrigation, Furrow irrigation, *Simulation analysis, Model studies, Mathematical models, Inflitration.

The best sets of controlling parameters in surface irrigation, border and furrow types, were determined by use of a numerical model. Four criteria for evaluating quality of irrigation were obtained and expressed as equations: degree of moistening of the active soil layer, efficiency of water use, productivity of mechanisms (dependent on length of furrows or border strips), and productivity of labor (dependent on labor, slope, and type of soil). Constraints were derived, including maximum permissible velocity of the irrigation stream, maximum permissible depths during irrigation, and desired rate of irrigation (ha per day). In an example, irrigation was simulated for each possible set of controlling parameters. A set of results which satisfied the constraints was presented in a table. These Pareto-optimal solutions can be further evaluated by the persons responsible for decision making. (Cassar-FRC).
W82-06781

FARM WATER MANAGEMENT GETS FAO BOOST,
World Water, Vol 5, No 6, p 33, 35-36, June, 1982.

Descriptors: *Water management, (applied), *Irrigation efficiency, *Developing countries, Education, Food and Agriculture Organization, Farm management, Organizations, Pilot tests.

In October 1980 the U.N. Food and Agriculture Organization (FAO) started a program for assisting governments of developing countries in promoting improved irrigation efficiency among small farmers. To overcome the shortage of personnel for training the farmers in the field, special courses were given high priority in educational institutions. Demonstration projects at the farm and village level were conducted in several countries. A pilot project in Pakistan, established before the FAO's action, contributed much background information in this effort. The social and physical constraints on good farm water management are usually inadequate operation of the main system, unreliable water delivery, inadequate operation of the main system, unreliable water delivery, inadequate farm size, tenure systems, and water rights. In the Philippines a pilot irrigation management project begins with a community organizer who lives in the locality and identifies needs through contact with the people. Later an engineer prepares a project design and cost estimates. A farmers' association is formed, and financing is provided by contributing labor and long-term loans. The Philippine program has produced 180 new irrigation systems since 1980 and substantial increases in rice production. Similar projects are underway in Sri Lanka, Egypt, Malaysia, Panama, Indonesia, Thailand, Bangladesh, South Yemen, Tanzania, Ghana, and Kenya. (Cassar-FRC)
W82-06815

DOUBTS REMAIN ABOUT BURA ECONOMICS,
World Water, Vol 5, No 6, p 46, 49, June, 1982. 1 Fig.

Descriptors: *Developing countries, *Irrigation, *Economic aspects, *Benefits, Bura Project, Tana River, *Kenya, Capital costs, Farms, Semiarid lands, Water resources development, Canals, Irrigation Canals.

The Bukra project in eastern Kenya has far exceeded original cost estimates, leaving the government with massive debts to repay. The project is opening a previously unfarmed, sparsely populated 6700 ha of semiarid land to settlers. High capital costs of $30,000 per family settling on 1.25 ha plots include housing, water supply, and other facilities. A recent economic evaluation estimated a return of 6.75% over the next 50 years, much less than the 13% predicted by the World Bank in 1977. Some major factors are the drop in cotton prices since the plan was conceived, increased costs, delays in construction, and high management and operation costs. The Bura scheme obtains water from the Tana River by diesel pumping through a 27 km supply canal, a 25 km main canal, 4 main branch canals, innumerable feeder canals, and siphon tubes. (Cassar-FRC)
W82-06816

COMPUTER-GUIDED LINEAR IRRIGATOR MARCHES ON,
World Water, Vol 5, No 6, p 53-54, June, 1982.

Descriptors: *Irrigation efficiency, *Computers, Water conservation, Wind, Spray irrigation, Mist irrigation, Irrigation equipment.

The Noble linear low pressure overhead irrigation system has been effective in the hot (up to 50 C) and windy (up to 80 km per hour) Mojave Desert. The diesel-powered apparatus combines computer technology and sophisticated nozzles for mist spray water delivery. Water is supplied through a buried mainline with risers onto which grabber tractors fix by computer command, ensuring constant distribution, Spraying is uninterrupted because one grabber is supplying water while the second is seeking out the next riser. Wind problems are almost eliminated because the spray booms are just above the head of the crop. Water savings are about 25%. Runoff, fertilizer teaching, and soil erosion are virtually eliminated. Computer cards allow the operator to quickly reprogram the apparatus for a chosen speed, water delivery ratio, or program. (Cassar-FRC)
W82-06817

BRANTAS DAMS TRIGGER NEW JAVANESE DEVELOPMENT,
World Water, Vol 5, No 6, p 40-41, June, 1982. 1 Fig.

Descriptors: *Irrigation, *Developing countries, *Dam construction, *Irrigation design, Water resources development, Dams, Brantas River, Java, *Indonesia, Crop yield, Lodoyo Project.

The Lodoyo irrigation project, soon to be completed in Java, will cover about 15,000 ha of land of which 9600 ha were not formerly cultivated and 6000 ha produced only one crop per year instead of the 2-3 crops per year possible with the new irrigation project. Water comes from below the Wlingi Dam on the Kali Brantas, a river which runs in a circular course around an active volcano. The Lodoyo project, consisting of a 32 km main canal, secondary and tertiary canals, will benefit about 450,000 people. Agricultural extension services are a part of the project. (Cassar-FRC)
W82-06818

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
B. Sherman, and V. P. Singh.
Water Resources Research, Vol 18, No 3, p 659-667, June, 1982. 7 Fig, 21 Ref.

Descriptors: *Model studies, *Surface irrigation, Kinematic waves, Kinematic wave theory, Soil water, Mathematical studies, Waves, Irrigation, Infiltration, Infiltration rate.

The kinematic model for surface irrigation as reported previously by Sherman and Singh is extended. Depending on the duration of irrigation and time variability of infiltration, three cases are distinguished. Explicit solutions are obtained when infiltration is constant. For infiltration varying over time, a numerical procedure is developed which is stable and has fast convergence. A rigorous theoretical justification is developed for computation of the depth of water at and the time history of the front wall of water advancing down an infiltrating plane or channel. A derivation is given of the continuity and momentum equations when there is lateral inflow and infiltration into the channel bed. (Baker-FRC)
W82-06852

CONSUMPTIVE USE OF WATER BY MAJOR CROPS IN THE SOUTHWESTERN UNITED STATES,
Science and Education Administration, Phoenix, AR. Water Conservation Lab.
L. J. Erie, O. F. French, D. A. Bucks, and K. Harris.
Conservation Research Report No 29, May 1982. 42 p, 11 Ref, 2 Append.

Descriptors: *Consumptive use, *Irrigation requirements, *Evapotranspiration, *Soil water, *Agriculture, Crop production, Water use, Water management, *Arizona, *Southwest U.S.

Water is a limiting factor in the expansion of irrigated areas and in the production of food for all Western States. Knowledge of consumptive use is necessary in planning farm irrigation and drainage systems, for improving irrigation practices, conserving energy, and assisting in irrigation scheduling. Consumptive use data are presented for 33 cash, oil, hay, bermuda lawn, small grain, forage, fruit, vegetable, and green manure crops as grown in central Arizona. Estimates of seasonal use, semimonthly use, and soil profile moisture depletion are included. Peak-use rates may be estimated from the consumptive use curves. Tentative irrigation schedules can be calculated directly from the consumptive use curves. Data from the figures can be used for irrigation scheduling in areas having growing seasons comparable to those in the Salt River Valley of Arizona. The seasonal consumptive use totals and peak consumptive use rates can be used for planning irrigation projects or farm irrigation systems. A simple method of utilizing this information in different but somewhat similar areas is the Blaney-Criddle formula. The main advantage of this method is that only temperature and sunshine hours are required. (Moore-SRC)
W82-06964

SOME CHARACTERISTICS OF CALCULATING THE WATER REQUIREMENT WHEN DESIGNING IRRIGATION MEASURES,
All-Union Scientific Research Inst. of Water Management Economics and Administration, Moscow (USSR).
T. F. Sokolovskaya, and G. A. Mitrofanov.
Water Resources, Vol 8, No 4, p 355-365, July/August, 1981. 4 Fig, 5 Tab, 12 Ref. Translated from Vodnye Resursy, No 4, p 48-59, July/August, 1981.

Descriptors: *Irrigation design, *Water transfer, *Water requirements, *Irrigation requirements, *Irrigation efficiency, Water conveyance, Probability distribution, Climatic zones, Crop rotation, Water management, Water deficit, Water supply, Seasonal variations, Winter wheat, Grain crops, *USSR.

Irrigation requirements are determined using the concept of asynchronism on fluctuation in the water requirement deficity of irrigated crops. This information allows efficient water transfer among basins, knowing climatic conditions at a particular weather station, the nature of the crops, and the probability percentage of the water requirement deficit. The method considers the probabilities of maximum mean daily water requirement deficits in 10-day periods, instead of assuming that the soil becomes increasingly and uniformly drier as the season progresses. The most efficient of 13 crop rotations may be chosen to manipulate the asynchronism artificially so as to gain the most efficient use of irrigation water. For example, in one climatic zone winter wheat requires the most water between the last third of March and the end of April. Decreasing the proportion of winter wheat in favor of alfalfa, spring wheat, or grain corn can shift maximum water requirements to other periods of the growing season. (Cassar-FRC)
W82-06984

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,
Kansas State Univ. Manhattan. Dept. of Geography.

For primary bibliographic entry see Field 7B.
W82-06994

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05918

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 3F.
W82-05924

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243494, Price codes: A03 in paper copy, A01 in microfiche. Report, August 1981. 42 p, 5 Fig, 7 Ref. OWRT A-071-IDA(1). 14-34-001-0114.

Descriptors: *Model testing, *Rivers, *Prediction, *Runoff forecasting, Model studies, River regulations, River basin development, River forecasting, Projections, Planning, Operating policies, Runoff, Forecasting, Streamflow, Reservoir stages, Water demand, Watersheds, *Idaho, *Upper Snake River, *Boise River.

Update planning models and procedures used by seven operational agencies in two Idaho river basins were investigated. These models and procedures were developed and updated to both improve accuracy and meet changing conditions by public agencies and private companies in the area. Each model and procedure has different objectives, in accordance with the intended purposes of each organization. While most of the models and procedures are computerized, some are still operated manually and most have no published references. They are used to predict runoff (from snow pack data), natural stream flows (from various hydrologic data), and reservoir levels, as well as to account for water diversions from rivers and to evaluate the effects of future demands on surface/ground water in a hydrologic basin. River operations and planning procedures depend on the ability to predict various parameters; however, while accurate streamflow prediction has received considerable attention, it is one of the weakest links in many of the predictive and modeling procedures. The results of this investigation are presented in the form of a narrative summary of the information collected from each organization using a prescribed outline format covering organizational objectives, descriptions of the models and procedures used, and evaluations by the organization. (Zielinski-MAXIMA)
W82-05925

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05926

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 6F.
W82-05930

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 2I.
W82-05967

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,
Nairobi Univ. (Kenya). Inst. for Development Studies.
For primary bibliographic entry see Field 6E.
W82-05987

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
S. Engel.
Report, April 1982. 33 p 9 Fig 3Tab 17 Ref.

Descriptors: *Lake basins, *Macrophytes, *Sediment control, *Algal control, Algal growth, Bottom sediments, Lake restoration, Biomass, Screens, Lake ice, Gravel, Vegetation.

Sediment blankets have been used to seal basins against seepage and groundwater pollution, but they might also be useful for plant control. Three types of sediment blankets (plastic liners, Bidim, Typar) and a polyvinyl-coated fiberglass screen (Aquascreen) were tested for their ability to control submersed macrophytes in two Wisconsin lakes. Conventional plastic liners, covered by sand or gravel to anchor them were densely overgrown when sampled 3, 4, and 7 years later. Bidim and Typar Blankets were covered with pea gravel, placed on one lake's ice cover and allowed to melt through. At other sites they were placed directly on the lake bottom and anchored with bricks. Bidim and Typar blankets are light and gas gets trapped beneath them, so it was difficult to keep them on the lake bottom. Algae and macrophytes took only a year to spread over the blankets. The plants grew just as well on gravel-covered blankets as on those without gravel. Because new Blankets must be added every few years, they have limited use for rehabilitating lakes. Aquascreen was easier to handle, trapped less gas, prevented macrophyte growth in spring, and eliminated growing plants in summer. A few stems penetrated the screen's mesh, but most plants grew on pockets of sediment. Relocating the screens in summer and removing them in the fall prevented sediments from accumulating. Aquascreen can be effective in temporarily suppressing macrophytes in limited areas of lakes. They can be set on the lake bottom or directly over the plants at any time in spring or summer. Aquascreen may be a practical, economical, and environmentally sound alternative to more traditional lake rehabilitation strategies. (Atkins-Omniplan)
W82-06097

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, W. A. Hall, and J. D. Salas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254996, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 111, September 1981. 32 p, 12 Ref. OWRT B-195-COLO(6), 14-34-0001-9060.

Descriptors: *Reservoir storage, *Mathematical equations, *Operating policies, *Reservoir operation, *Optimum development plans, Water storage, Storage tanks, Balancing reservoirs, Reservoirs, Equalizing reservoirs, Mathematical studies, Flood-control storage, Flood control, Planning, Design criteria.

Research was carried out toward assistig water authorities in determinig optimal operatig policies for reservoir systems. This research sought, amont other factors, to develop a methodology (including policy criteria, principles, techniques) for designing the objective functions for planning/operating water storage reservoirs, and to introduce a time factor into the objective functions to represent their continuous evolution. Based on these results, changes are recommended in defining criteria for optimal state reservoirs. Conceptualization of an equivalent reservoir (as an alternative to multireservoir operational schemes/algorithms) was also accomplished. Assessment of the anticipated decision influence period (ADIP) and risk quantification indicated promising approaches; the use of ADIP to develop indices of operational decisions on risks avoidance and operational benefits is theoretically treated employing mass balance equations for discrete time periods (considering inflow, demand, evaporation loss, seepage, spill loss). Further risk formulated rules gave considerable improvement over normal operations for small reservoirs, with even greater improvement for large reservoirs. The use of ADIP in flood operational policies is also considered. (Zielinski-MAXIMA)
W82-06175

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
S. B. Jones.
Proceedings of the Institution of Civil Engineers. Part 2, Research and Theory, Vol 71, No 3, p 759-772, September, 1982. 6 Fig, 17 Ref.

Descriptors: *Flood routing, *Model studies, Routing, Floods, Flood control, Flood forecasting, Flood flow, *Muskingum-Cunge Model, Mathematical models, Mathematical equations.

Hydraulic and hydrologic problems frequently require techniques for modeling the propagation of flood waves along river channels and sewer pipes. The basic equations for gradually varying, unsteady flow in an open channel of small bed slope are the St. Venant equations; these have no analytical solutions, but several numerical techniques have been proposed to solve them, including the method of characteristics and implicit or explicity finite-difference schemes. An example of the last-named type of approach is the explicit variable parameter Muskingum-Cunge method. A modification of this method is presented in which the space and time increments can be chosen objectively to take into account the observed fact that the solution to the convection-diffusion parameter must be selected, depending on channel morphology. Values of the space step and the time step may be selected according to one of three approaches, depending on whether or not one of them is more clearly defined by the physical model under consideration. (Baker-FRC)
W82-06227

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,
Ecole Nationale des Ponts et Chaussees, Paris (France).
J. M. Gaillard, and J. A. Mawdsley.
Hydrological Sciences Bulletin, Vol 27, No 2, p 159-171, June, 1982. 1 Fig, 7 Tab, 22 Ref.

Descriptors: *Reservoirs, *Estimating, Water supply, *Yield, Flow discharge, Water resources development, Error analysis, Errors, Europe.

The error of the estimate of the yield of a direct supply reservoir due to limited data was investigated for conditions prevailing in the northwest of Europe using the errors of the 2% design drought for durations up to 36 months as a measure of this error. Two methods of estimating the 2% drought were considered. First, the monthly design

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drought, and second, an empirical procedure which required only rainfall data were the two measures employed. The expected errors for both the direct estimation and the empirical methods are a function of the flow variability of the data records chosen. Since the records used are thought to be representative of European runoff, the comments made are valid only for this region. Other regions with similar flow variability may be able to use these findings. The errors for the design drought were found by splitting a 500 year monthly flow record into shorter records. The 500 year record was obtained by extending an historic record of 111 years using the Thomas Fiering model. To estimate errors of the empirical procedure, the widely used method of Law, which uses rainfall data and the mean annual losses to estimate the design drought, was applied to 13 catchments with historic records greater than 30 years. The error of the empirical procedure was found from the differences between the empirical procedure and the estimate from the historic data. When the results from the two analyses were compared, the accuracy of the empirical procedure for all durations was equal to the accuracy obtained from a record of between 10 and 20 years. (Baker-FRC)
W82-06300

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.
Soil Conservation Service, Boise, ID.
For primary bibliographic entry see Field 6G.
W82-06409

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 419-441, March, 1982. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Streamflow, *Stochastic process, *Mathematical models, Comparison studies, Monthly distribution.

Models which have been developed to generate monthly flows for use in the design and operation of water resources systems can be broadly classified as monthly flow models or as disaggregation processes. The monthly flow models use an autoregressive model for the generation of monthly flows. The disaggregation models distribute annual flows generated by an annual model into monthly flows. A review of variations of these models is followed by a comparison of three monthly models: the Thomas-Fiering monthly model, which automatically takes seasonal variations into acount in the generating equation; the two-tier model, in which monthly flows generated by a Thomas-Fiering monthly model are adjusted against the annual flows generated by an appropriate annual model; and the method of fragments, which is a disaggregation process in which the observed monthly flows are first standardized year by year, followed by disaggregation of the annual flows obtained from any of the annual models into monthly flows using the sets of standardized monthly flows in each year selected at random. Application of these three models to several streams in Australia showed that the Thomas-Fiering monthly model preserved the seasonal monthly parameters for all the streams, although it gave smaller storage estimates than the historical values. The two-tier model and the method of fragments gave improved storage estimates and preserved the annual parameters. All the models gave similar results for the overall parameters for less variable streams, although the modified two-tier model preserved the seasonal monthly parameters better than the other models. It is suggested that a modified two-tier model be used for less variable streams. The method of fragments is recommended for use with highly variable streams, since it yielded smaller values for skewness than the modified two-tier model for these streams, even though it did not preserve the seasonal monthly parameters as well as the two-tier model. (Carroll-FRC)
W82-06427

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,
Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
For primary bibliographic entry see Field 6G.
W82-06429

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
K. C. Gilbert, and R. M. Shane.
Journal of the Water Resources Planning and Managemet Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 21-36, March, 1982. 1 Fig, 38 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

The hydro system simulation (HYDROSIM) model has been developed by the Tennessee Valley Authority to model long-term week-to-week variations in water level, discharge and electric power generation for its complex reservoir system. The basic optimization step in the HYDROSIM model determines optimal end-of-week storage for individual reservoirs, given beginning-of-week storage and weekly unregulated inflows. Scheduling of the 42-reservoir system poses a stochastic, nonlinear, multireservoir problem with both nonviolable physical constraints and violable operating constraints. An 'observe flow then determine release' stochastic formulation is used to simulate operation for 1 to 20 weeks into the future using historical flow sequences. A system of preemptive priority operating constraints is implemented using separable linear programming with upper bounding. A nonlinear power cost function is then minimized subject to the system of priority constraints. The search procedure involves solution of a sequence of linear programs in order to solve the nonlinear optimization problem. (Carroll-FRC)
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
R. M. Shane, and K. C. Gilbert.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 1-19, March, 1982. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, *Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

Computer programs and mathematical methods have been developed to model long-term week-to-week variations in water level, discharge, annd electric power generation for the complex reservoir system operated by the Tennessee Valley Authority. The model has been developed for use in day-to-day planning for operation of the 42 reservoirs and for policy and project studies. The models were intended to meet the need for more efficient use of historical data, better evaluation of new operating requirements, improved long-range guidance, and integration of weather forecasts with guides for operations planning. The hydro system simulation model has been designed to be used by TVA reservoir management personnel to evaluate the impact of new operating requirements on established objectives; to continually check the current reservoir system status to warn of possible future problems; to forecast reservoir operation in terms of possible and likely pool level and discharge variations, constraint violations, and generation characteristics expected in the next 1 to 52 weeks of operation, and to develop new long-range operating guides. The model includes the capability to observe important system operating constraints and priorities; extreme event analysis capability; a special linear programming structure which provides the flexibility necessary to modify operating objectives and to experiment with new types of long-range efficiency guides; and interactive CRT graphical output analysis. (Carroll-FRC)
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
O. J. Helweg, R. W. Hinks, and D. T. Ford.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 169-179, June, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Reservoir operation, *Optimization, *Model studies, Systems analysis, Central Valley Project, California, Tennessee Valley Authority, Drought, Multipurpose projects, Hydroelectric plants, Computers, Data processing.

Optimixzation models for reservoir operation, available for over a decade, are not used at present by any major reservoir system or real time operation. Model development and implementation experiences at representative systems, the Central Valley Project in California and the Tennessee Vally Authority, were examined. At the Central Valley Project a pilot study begun in 1965 led to a series of investigations designed to improve the applicability of optimization techniques to a real-life situation. Monthly and daily models were developed. A complicated hourly model was in the development stage when severe drougnt hit California in 1976. The models were unable to handle the related data inputs. Modifications to the model, made without help from the model builder, produced an inconvenient and unmanageable model. After the drought, work on omptimization models was discontinued. It was estimated that the use of optimization models would produce a benefit-cost ratio of over 17. Computers were first used in the 34 reservoir Tennessee Valley Authority system in 1951. In 1971 an effort to develop models to aid in choosing optimal operations strategies began. At present progress has attained the model validation stage. As of late 1979 no optimization models had been implemented. Basic problems identified in this investigation were lack of upper management support, lack of well qualified and interested personnel involved in the modeling effort, inadequacies of the models (inflexibility, large data requirements, unrealism), and chance occurrences such as the drought, personnel changes, and computer system incompatibilities. The author feels that these problems are all solvable and that adoption of optimization models would substantially increase savings for reservoir operations. (Cassar-FRC)
W82-06433

COMPARING URBAN RUNOFF MODELS,
For primary bibliographic entry see Field 2A.
W82-06447

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06631

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 6B.
W82-06696

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,
George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
For primary bibliographic entry see Field 6B.
W82-06704

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 2E.
W82-06717

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
W. Wahliss, and L. A. Siegerstetter.
Wasserwirtschaft, Vol 72, No 1, p 12-17, 1982. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Multivariate analysis, *Regression analysis, *Time series analysis, *Stream discharge, *West Germany, Danube river, Main river, Diversion, Mathematical models, Projections, Statistical analysis, Flow discharge, Hydrologic systems, Hydrologic models.

An autoregressive multivariate multilag model is presented with which hydrologic time series that are correlated along both the time and space axes can be simulated. Stepwise linear regression is used to determine the regression coefficients. This method establishes a relationship between a goal value and several influencing values that only contains significant regressors. Raw data obtained through the model must be transformed into the normal distribution and standardized before the model can be analyzed. The model was applied to a hydrological system for diverting water from the Altmuhl and Danube rivers to the Regnitz-Main region in West Germany. The system consists of three reservoirs and the natural and manmade channels that connect them. Streamflow was simulated with an autoregressive process with a power of three in eight of the system's water gages. Data collected over a period of 47 years were used to simulate weekly flow. For transformation of the data into the normal distribution, the logarithmic method was best (used in 64% of cases), followed by the Pearson-III function (about 30%). In 100-year series the results showed large chance fluctuations, which was not true of 500-year series. A slight tendency to the overestimation of correlations was seen with increasing lag. The model may also be used to generate monthly and 10-yearly streamflow. (Gish-FRC)
W82-06826

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
A. H. M. Gorgens, and D. A. Hughes.
South African Journal of Science, Vol 78, No 2, p 58-68, February, 1982. 8 Fig, 7 Tab, 28 Ref.

Descriptors: *Semiarid lands, *Streamflow, Hydrology, Arid lands, Semiarid climates, Karoo Biome, *South Africa, Statistical models, Water resources development.

An overview of the extant streamflow monitoring network and available relevant publications concerning the Karoo Biome is presented, along with an analysis of the statistical characteristics of annual and monthly streamflow volumes, low-flow phenomena and flood peaks of a representative set of river basins. Comparisons with other studies and the streamflow characteristics of other climatic zones are also drawn. Implications are discussed for the proper assessment of the surface water resources potential of the Karoo Biome. Such an assessment would be seriously constrained by the twin problems of the poor spatial distribution of reliable streamflow-gauging stations and the paucity of streamflow records of long duration and acceptable quality. A technique that may ease these constraints is that of deterministic rainfall-runoff modeling. The generation of synthetic streamflow records for assessments of water resources potential is also possible by means of stochastic time series modeling, albeit restricted to gauged catchments. The erratic nature of runoff, poor natural carry-over storage, and the low runoff proportions from rainfall in the Karoo catchments may be seen as end effects of a rather tenuous hydrological equilibrium. The response of these catchments to rainfall is likely to be very sensitive to changes induced by land use and management. This hydrological sensitivity underlies the fragile nature of all semi-arid ecosystems and may manifest itself in changes in runoff quality as well as quantity. (Baker-FRC)
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,
Massachusetts Inst. of Tech., Cambridge.
K. P. Georgakakos, and R. L. Bras.
Water Resources Research, Vol 18, No 3, p 513-524, June, 1982. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Model studies, *Flood routing, Bird Creek Basin, *Oklahoma, Routing, Floods, Flood control, Statistical models.

A linearization scheme was developed that makes it possible to use nonlinear routers in an accurate and effective way within the realm of the common linear estimation techniques. The technique also offers the advantage of simultaneous automatic parameter estimation in a simple manner. The Bird Creek example is included to show the feasibility of actual implementation and the effectiveness of the technique. It was concluded that nonlinear routing improves the behavior of the National Weather Service (NWS) model with a linear router. The adaptive nonlinear router is an improvement over its own off-line behavior. Statistical linearization in conjunction with the Taylor Gauss methodology is a powerful tool of analysis for the flood forecasting problem. The conceptual nonlinear flood routing model used can reproduce most of the characteristics of observed output hydrographs, while it does not require high quality input data for the determination of initial parameter values. The automatic parameter estimation scheme is effective and shows promising convergence properties. The use of the model for different flood events in different catchments would increase its credibility. (Baker-FRC)
W82-06855

COMPUTATION OF RUNOFF REDUCTION CAUSED BY FARM PONDS,
Science and Education Administration, Chickasha, OK. Southern Plains Watershed and Water Quality Lab.
R. R. Schoof, and G. A. Gander.
Water Resources Bulletin, Vol 18, No 3, p 529-532, June, 1982. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Runoff, *Ponds, Water storage, Mathematical models, Data collection, Agricultural runoff, Rainfall-runoff relationships, Rainfall, Watersheds, Surface water, Surface runoff, Farm ponds.

A simple accounting method is given for relating the runoff contributing area of watersheds to an index of water in farm pond storage. The procedure was tested on three watersheds. The farm pond storage index, FPSI, could be used with any surface water runoff model on watersheds with several farm ponds and reasonably linear distribution of storage capacity among the ponds. A daily accounting of water stored in all the farm ponds on a watershed was made by daily adjustment of the FPSI, which is defined as the number of inches of watershed runoff stored in the pond that had the largest storage per unit of its drainage area. Rainfall and evapotranspiration computed by a Jensen-Haise equation were input to the model. A linear relationship was assumed between the storage index and the portion of the controlled drainage area that was contributing to runoff. Adjusting the computed runoff with the FPSI reduced the coefficient of variation of monthly measured versus computed surface runoff for each of the three watersheds. The correlation coefficients for the same comparisons were increased. The annual predicted surface runoff was improved for 12 of the 17 station years of data tested. A test of the significance of the improved simulation using the FPSI indicated at the 95% confidence level that there was some improvement. The farm pond storage index could be used with any surface runoff model to improve the prediction of runoff from watersheds with drainage areas greater than 1 square mile and with about 20% or more of the drainage area controlled by farm ponds. (Baker-FRC)
W82-06874

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,
Kinnert Limnology Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W82-06879

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,
Geological Survey, Sacramento, Calif. Water Resources Division.
J. C. Blodgett.
Open-File Report 81-1010, March 1982. 32 p, 11 Fig, 11 Tab, 8 Ref.

Descriptors: *Flood flow, *Streamflow, *Flow characteristics, *Bridges, Levees, Channel morphology, Flow rates, Discharge measurements, Flood profiles, Agriculture, Flood plains, Flood data, *California, Honcut Creek.

State Highway 70 crosses Honcut Creek about 3.2 miles upstream from its confluence with the Feather River, by three bridges separated by short approach embankments. The California Department of Transportation is planning to replace or widen these bridges; this report evaluates flow characteristics of the existing and proposed crossings. Agricultural improvements on the flood plain and low levees affect the magnitufe and distribution of flow to the bridges. Water-surface elevations of Honcut Creek are affected by levees on the flood plain, a natural channel constriction about 3,000 feet downstream from the bridges, and by high water levels on the Feather River. The average recurrence interval for overbank flow is less than 2 years. A flood with an average recurrence interval of 50 years would be about 19,000 cubic feet per second. For flows of 20,000 cubic feet per second on Honcut Creek, and with present bridge conditions, backwater caused by the bridge is about 0.4 foot. If the left-bank bridge is eliminated, backwater would increase to 0.5 foot. The bridges and approach embankments occupy about 66 percent of the channel. The average velocity of flow at the bridge ranges from 1 to 3.2 feet per second. For present channel and bridge conditions, overbank flows are distributed among the three bridges in a proportion of about 10, 40, and 50 percent for flows between 2,850 and 8,480 cubic feet per second. (USGS)
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,
Geological Survey, Denver, Colo. Water Resources Division.
For primary bibliographic entry see Field 2E.
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and E. E. Webber.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.25, Microfiche $4.50. Open-File Report 81-414, 1981. 7 p, 2 Fig, 5 Ref

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Descriptors: *Floods, *Flood flow, *Flood discharge, *Flood recurrence interval, Flood frequency, Hydrologic data, *Ohio, Gallipolis, Chickamauga Creek basin.

An intense summer rain estimated at 4 to 5 inches in 2.5 hours caused flooding on a Chickamauga Creek tributary 4.5 miles northwest of Gallipolis, Ohio. Computation of a peak discharge of 1,350 cubic feet per second from 3.03 square miles of drainage area (446 cubic feet per second per square mile) indicates a greater-than-100-year flood. (USGS)
W82-06947

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGUOULA, AND TENNESSEE RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06955

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06957

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
For primary bibliographic entry see Field 4C.
W82-06983

4B. Groundwater Management

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 6E.
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05940

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,
Komenskeho Univ., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2F.
W82-05943

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, H. Fabris, D. Thiery, and A. Menjoz.
Water Resources Research, Vol 18, No 2, p 253-265, April, 1982. 11 Fig, 3 Tab, 18 Ref.

Descriptors: *Water storage, Water resources development, *Model studies, *Thermal water, *Injection wells, *Confined aquifers, Resources development, Aquifers, Project planning, Aquifer management, Resources management, Water temperature.

Hot water storage in a single well or in a pair of wells (doublet) in the French Jura was examined in ten successive experiments conducted in 1976-1977 in a confined aquifer 2.5 m thick. Injected volumes ranged from 500 to 1700 cu m, and temperature profiles were taken daily in 12 boreholes distributed along two perpendicular axes within 13 m of the injection well. Individual temperatures were recorded by thermistors placed in the caprock, and results were used to calibrate two mathematical models. An axisymmetric model allows the calibration of average values of the parameters, while a three-dimensional model determines their spatial variation in the horizontal plane and identifies a nonhomogeneous transmissibility field for both hydraulic and thermal contour curves. The water content of the caprock and the thermal dispersion in the aquifer proved important to the recovery ratio. Use of the model in Auburn showed adequate predictions of water temperature during the production phases. (Geiger-FRC)
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, A. C. Menjoz, and P. A. Landel.
Water Resources Research, Vol 18, No 2, p 245-252, April, 1982. 7 Fig, 4 Tab, 14 Ref.

Descriptors: Water resources development, *Project planning, *Water storage, *Mathematical models, *Injection wells, *Economic aspects, *Aquifer management, Resources development, Geothermal resources, Planning, Aquifers, Model studies, Thermal water, Heated water, Groundwater storage.

A general study was undertaken to assess the economic feasibility of aquifer heat storage projects using a single well. A mathematical model shows that storage efficiency and temperature are influenced by a limited number of dimensionless groups that are controlled by the aquifer's physical properties and its storage operating characteristics. A numerical model is compared with analytical solutions before being used to evaluate the variation with time of the well temperture when production volume and flow rate are equal to the injection volume and flow rate. These results are utilized to plot type curves for several sets of dimensionless parameters covering a range of practical applications. Suggestions are made for efficient storage projects, and the effects of unequal injection, production periods, standby periods, and other conditions of operation are also examined. (Geiger-FRC)
W82-06059

DAILY OPERATIONAL TOOL FOR MAXIMUM BENEFICIAL USE MANAGEMENT OF SURFACE AND GROUND WATERS IN A BASIN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, K. L. Verdin, and T. H. Illangasekare.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254988, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 112, March 1982. 39 p, 18 Fig, 2 Tab, 7 Ref. OWRT B-199-COLO(4), 14-34-0001-9109.

Descriptors: Hydrologic models, *Geohydrology, *Surface water, *Surface-groundwater relations, *Water management, *Basins, Management planning, Numerical analysis, Computer models, Model studies, Hydrologic systems, Hydrologic data, Hydrologic equation, Hydrologic systems, Hydrologic aspects, Hydrologic budget, Groundwater budger, Groundwater, Mathematical studies, Subsurface water.

A developed two-dimensional groundwater hydrologic model, based on numerical-analytical procedure, is preseted and tested. This model incorporates, the discrete kernel modeling approach, a scanning sub-system and sequential reinitialization. Further, it possesses an ability to compute drawdowns at particular locations rather than only average values over cells to provide new input to standard modeling approaches. The model was tested for accuracy and economy. It was found that it consistently will provide results of at least comparable accuracy to that attained with standard finite difference techniques, provided that its variables are properly selected. In addition, the developed model, in certain cases, provides solutions closer to the true solution. The model can also generate solutions with comparable accuracy at reduced cost relative to other computer models, provided that judicious selection of the model's input for sub-system size and reinitialization period is made. The model is particularly efficient if more than one simulation run is to be made on the same system. Appropriate use of the model should substantially reduce the cost of management studies on conjunctive use of surface water and groundwater. (Zielinski-MAXIMA)
W82-06174

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,
Windrem, Feeney and Williams, Lakeport, CA.
For primary bibliographic entry see Field 6G.
W82-06217

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,
O'Melveny and Myers, Los Angeles, CA.
For primary bibliographic entry see Field 6E.
W82-06218

DESIGN OF HEAT PUMP RETURN WELLS,
Michigan Dept. of Public Health, Lansing.
For primary bibliographic entry see Field 8C.
W82-06294

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06303

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
S. Snipes.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256553, Price codes: A06 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson, Publication No 93, June 1981. 87 p, 18 Fig, 9 Tab, 40 Ref, 8 Append. OWRT A-047-SC(1).

Descriptors: Water quantity, Water quality, *Lineaments, *Fracture traces, *Fracture zones, Joints, Faults, *Metamorphic rocks, Drilled wells, Bored wells, Hand dug wells, Springs, *South Carolina, Piedmont, *Chemical analysis, Coliform bacteria, Pollutant identification, *Water wells.

More than 200 water well locations have been plotted in Anderson and Oconee Counties in the Piedmont of northwestern South Carolina. The coherent rocks of this metamorphic terrain are virtually impermeable and the median yield of water wells randomly situated in them is only 4 gpm. Moreover, the risk of a dry hole in such wells is 1 in 4. In contrast, water wells situated in fracture zones have a median yield of 20 gpm while the probability of a dry hole is 1 in 71. Nearly all of the wells with yields of greater than 50 gpm are situated in fracture zones and yields of more than 400 gpm have been reported. Aerial photographs and topogrphic maps were analyzed to locate fracture traces and lineaments. Field studies have shown that most of them are attributed to vertically dipping systematic joints or fault zones. More than 400 linear features have been mapped; 43 of them are fault zones, while most of the remainder are attributed to systematic joints. Fifty-eight ground water samples were analyzed for their chemical properties and 48 samples were analyzed for their content of coliform bacteria. Most of the ground water samples had good to excellent chemical properties. Twenty-four percent of the rural, shallow, hand dug wells had fecal contamination and 1 of the 8 spring samples showed fecal contamination. The drilled and bored wells contained very little bacteria and no fecal contamination. (Author abstract)
W82-06309

A TWO-DIMENSIONAL, FINITE ELEMENT MODEL OF SALT WATER INTRUSION IN GROUNDWATER SYSTEMS,
Guam Univ., Agana. Water Research Inst. of the Western Pacific.
D. N. Contractor.
Technical Report No 26, October 1981. 64 p, 9 Fig, 16 Ref, 4 Append.

Descriptors: *Model studies, *Saline-freshwater interfaces, *Saline water intrusion, *Aquifers, Coastal waters, Water boundary, Groundwater movement, Flow rates, Computer programs, Fortran.

Careful management of aquifers with coastal boundaries is essential to guard against excessive salinity concentrations. Management includes knowing the location of the saltwater under present and future pumping conditions. A numerical model can help estimate the location of the saltwater for given sets of hydraulic conditions. This report describes the development and use of a sharp interface model to simulate salt-water intrusion into coastal and insular groundwater aquifers. The model, using linear triangular elements, can simulate steady or unsteady conditions in confined or unconfined aquifers. Three types of boundary conditions can be specified: head as a function of time; flow as a function of time; and a mixed boundary condition for freshwater flowing into a coastal boundary. Freshwater wells can be located at any node. Freshwater and saltwater toes can be tracked with time, and the direction and velocity in each element can be identified. In addition, aquifers containing only freshwater can be simulated by specifying the saltwater head at all nodes to be much less than expected freshwater heads. The model has been used to simulate several natural aquifers, with complex boundaries, and varied basement topography and boundary conditions. The results were compared with analytic solution and, in all cases, the comparisons were good availability of such a model enables the manage an aquifer to explore the advantages and disad tages of various options relating to the deve ment of the resource. The computer program has been written in FORTRAN. (Atkins-Omniplan)
W82-06525

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,
Youngstown State Univ., OH Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-06584

AN OPTIMIZATION ALGORITHM IN A SYSTEM FOR MANAGEMENT OF THE REGIONAL SAFE GROUNDWATER YIELD,
Moscow State Univ. (USSR). Inst. of Mechanics Research.
E. V. Guseva.
Water Resources, Vol 8, No 3, p 329-336, May/June, 1981. 1 Fig, 3 Tab, 3 Ref. Translated from Vodnye Resursy, No 3, p 167-175, May/June, 1981.

Descriptors: *Safe yield, *Aquifer management, Groundwater management, Seepage, Numerical analysis, Model studies, Suzak Basin, *USSR, Optimization, Geohydrology, Wells, Mathematical models, Hydrodynamics.

A linear problem for conditions of confined seepage was examined. The numerical calculations of the prediction of cones of depression for a period up to 30 years were done using data from the Suzak artesian basin in Central Asia. The objective was to obtain the maximum possible amount of water in a given region with prescribed restrictions on the decline of the water table. Two variants of the problem were considered: (1) locations of the water intakes were fixed, and (2) the locations of the water intakes were unknown and to be determined. The method was satisfactory for managing safe regional yields. (Cassar-FRC)
W82-06616

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6B.
W82-06694

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
For primary bibliographic entry see Field 6B.
W82-06700

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,
Novosibirsk State Univ. (USSR)
For primary bibliographic entry see Field 7C.
W82-06784

WHO OWNS NEBRASKA'S GROUND WATER,
Nebraska Univ. Lincoln.
For primary bibliographic entry see Field 6E.
W82-06819

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-06831

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-06949

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-06950

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
H. T. Buxton, J. Soren, A. Posner, and P. K. Shernoff.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $8.25 Microfiche $3.50. Open-File Report 81-1186, 1981. 59 p, 28 Fig, 2 Tab, 25 Ref.

Descriptors: *Groundwater, *Water quality, *Groundwater potential, *Water supply, Water management, Available water, Urban hydrology, Water use, Saline water intrusion, Contamination, Aquifer characteristics, Wells, Water level, Chemical anlaysis, *New York, *Long Island, Kings County, Queens County.

Western Long Island's ground-water resources are being considered for redevelopment as a supplemental source of public water supply. The groundwater reservoir in Kings and Queens Counties had supplied an average of more than 120 million gallons per day for industrial and public water supply from 1904 to 1947. However, deterioration of groundwater quality from induced encroachment of salty ground-water caused the total cessation of pumping for public supply in Kings County in 1947 and in western Queens County in 1974. This investigation was designed to make a preliminary evaluation of the present groundwater quality and to review hydrologic information pertinent to the formulation of an appropriate development plan. Detailed hydrogeologic mapping was done to define the geometry of the ground-water system. The history of ground-water development and the consequent responses of ground-water levels and quantity were summarized. A well network was established to monitor ground-water levels and ground-water quality in Kings and Queens Counties. The distribution of chloride and nitrate in ground-water was used to identify contamination from salt-water intrusion and surface sources. A limited source of potable ground-water is available in the Magothy-Jameco and Lloyd aquifers; however, an accurate estimate of the quantity of water available or a draft rate suitable for maintaining a useable ground-water quality is undetermined. (USGS)
W82-06952

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06956

4C. Effects On Water Of Man's Non-Water Activities

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W82-06096

URBAN CREEKSIDE DESIGN FEATURES PARALLEL STREETS,
Santa Clara Valley Water District, CA.
L. C. Fowler, and S. N. Wolfe.
Civil Engineering (New York), Vol 52, No 6, p 72-74, June, 1982. 3 Fig.

LIBRARY U. OF I., URBANA-CHAMPAIGN

Descriptors: *Flood control, *Community development, *Urban planning, Construction, Design criteria, *Land use planning, Parallel streets.

Proper land use restraints and creative design can be used to prevent flooding and preserve the natural wildlife habitat which forms along a waterway, even in an urban setting. Streets parallel to waterways in developed areas separate the streams from neighboring houses, emphasizing open space and providing neighborhood privacy and security. Communities benefit more if creeks and channels are kept in the open where the public can see and use them. Maintenance is easier because of convenient access, and minor erosion or silt deposition does not create an immediate hazard to adjoining property. The design of parallel streets reduces the number of bridges required along the channels, thus reducing total cost to the community. Variations in the pattern of streets on both sides of and parallel to creeks can be made by looping streets or using dead-end streets, which reach to the creek margins. In valleys where the stream channel is located on higher elevations, levees are needed along the banks of the stream to contain the floodwaters. By setting the levees back away from the actual stream channels, the natural corridor is maintained and the carrying capacity enlarged to reduce the flood potential to the urban areas adjacent to the streams. (Baker-FRC)
W82-06184

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2J.
W82-06336

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,
CH2M Hill, Bellevue, WA.
For primary bibliographic entry see Field 2J.
W82-06553

FIRST-YEAR EFFECTS OF CLEARCUTTING AN OAK-HICKORY WATERSHED ON WATER YIELD,
Illinois Univ. at Urbana, Champaign. Dept. of Forestry.
R. J. Brozka, G. L. Rolfe, and L. E. Arnold.
Water Resources Bulletin, Vol 18, No 1, p 139-145, February, 1982. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Water yield, *Forest watersheds, *Clear-cutting, Forest management, Forest hydrology, Water quality, Nutrients, *Illinois.

Although water has always been a dominant consideration in forest management objectives, it is only recently that the effects of forest harvesting on water quality have been investigated intensely. The present study evaluated the effects on water quality of clear-cutting in southern Illinois, where soils are generally shallow, easily eroded, nutrient deficient, and on steep slopes, and where rainfall is relatively heavy. Two intermittent streams on oak-hickory watersheds were gaged with a V-notch weir and sampled with an automatic water sampler. Baseline data collected for 3 years showed large variations in flow volume between years and between watersheds. Analysis of water samples for sodium, potassium, calcium, magnesium, orthophosphorus, and nitrate-nitrogen (NO3-N) showed that water quality was consistently high, although there were significant differences between the watersheds, there was a 95% increase in flow volume, although there was no evidence of increased sedimentation. Stream water concentrations of potassium, magnesium, and nitrate-nitrogen increased 18%, 8%, and 274% respectively. Nutrient budgets for the site were not adversely affected by the harvest, due largely to the care taken to avoid disturbance to the site during logging, the careful layout of the harvest operation, and the below-normal precipitation the first year following the harvest. These results indicate that clearcuts of moderate size which are carefully planned and carried out should not pose a threat to water quality nor degrade site productivity. (Carroll-FRC)
W82-06589

REDUCTION OF URBAN RUNOFF THROUGH ECONOMIC INCENTIVES: BOULDER, COLORADO,
Colorado Univ., Longmont.
S. A. Thompson.
Water Resources Bulletin, Vol 18, No 1, p 125-127, February, 1982. 4 Ref.

Descriptors: *Urbanization, *Urban runoff, *Runoff volume, *Storm runoff, Economic incentives, Economic aspects, Flood control, Regulations, Boulder, *Colorado.

The process of urbanization results in fundamental alterations of interrelationships within the natural environment. The most obvious of these changes is the increased percentage of precipitation which becomes direct surface runoff as a result of the transformation of the land surface from a permeable to an impermeable covering. In 1974 the city of Boulder, Colorado, adopted storm drainage and flood control fee designed to charge property owners for altering the natural environmental relationships among precipitation, infiltration, and runoff and to encourage these owners to decrease their contributions to surface runoff. Single family residential lots are assessed $1.00 per month. All new developments other than single family lots which are not part of a larger development are required to install on-site detention storage facilities capable of controlling the runoff asssociated with a storm having a 5-year frequency, in return for which they receive a 20% reduction in the normally computed fee. If it provides storage capable capable of controlling runoff from storms with return frequencies of 10, 20, or 100 years, the parcel receives a 40, 60, or 80% reduction in the fee, respectively. Although most new developments have included detention storage facilities exceeding the minimum required, there have been no reports of retrofitting existing developments with such facilities. Also, only three single family residences have installed detention facilities. It is suggested that more could be done to encourage and assist homeowners to install detention facilities and to ensure that owners of existing developments understand the benefits of retrofitting their properties with detention storage. (Carroll-FRC)
W82-06629

EVALUATION OF EFFECTS OF STORMWATER DETENTION IN URBAN AREAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W82-06698

STREAMFLOW CHANGES AFTER LOGGING 130-YEAR-OLD DOUGLAS FIR IN TWO SMALL WATERSHEDS,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
R. D. Harr, A. Levno, and R. Mersereau.
Water Resources Research, Vol 18, No 3, p 637-644, June, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Watershed management, *Water resources development, Watersheds, Forest watersheds, Logging, *Oregon, Streamflow, *Douglas fir trees.

A case history was prepared of changes in streamflow observed after harvesting in two small experimental watersheds. The study area consists of three small watersheds located between the 865 and 1155 meter elevations on the south aspect of Blue Ridge, the major divide between the Blue River drainage to the north and the Lookout Creek watershed which comprises the H. J. Andrews Experimental Forest. Timber harvest in watersheds containing 130 year old timber increased annual water yield up to 42 cm. For 4 years after logging, yield increases averaged 38 cm at a 13.0 ha clearcut watershed and 20 cm at a 15.4 ha watershed where timber was shelterwood cut. Increased summer flows were indicated by the much smaller number of low-flow days after logging, particularly at the clearcut watershed. During the 1977 drought year, only eight and two low-flow days occurred at the clearcut and shelterwood cut watersheds, respectively, compared to 143 and 135 low-flow days predicted by the calibration relationship. Neither the size nor the timing of peak flows changed significantly after logging at either watershed. (Baker-FRC)
W82-06849

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,
Geological Survey, Orlando, FL.
For primary bibliographic entry see Field 5B.
W82-06877

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,
Maine Cooperative Fishery Research Unit, Orono.
For primary bibliographic entry see Field 5C.
W82-06910

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 5C.
W82-06965

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
V. S. Perekhrest, and S. M. Perekhrest.
Water Resources, Vol 8, No 4, p 365-369, July/August, 1981. 1 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 4, p 60-65, July/August, 1981.

Descriptors: *Land management, *River flow, *Drainage effects, Water management, Runoff, Dnepr River, *USSR, Irrigation effects, Lakes, Reservoirs, Agriculture, Water use, Precipitation, Rainfall-runoff relationships, Economic development, Flow, Environmental effects, Ecological effects.

The Dnepr Basin is an example of several basins in the European SSR which display noticeable changes in river runoff as a result of anthropogenic influences such as irrigation, drainage, construction of reservoirs and ponds, and erosion control. Examination of the chronological variation of precipitation and runoff and the residual mass runoff curves for the Kiev gaging station revealed 3 cycles of variations in discharge volume of the Dnepr. The first period (1881-1919) was characterized by little economic activity in the area except some drainage work. During the second period (1920-1942) runoff was still under nearly natural conditions. Drainage work involved only 350,000 ha out of 6.5 million ha. Some land improvement and erosion control projects begun in the 1930's were interrupted by World War II. In the third period (1943-1971) extensive drainage projects, reservoir construction, forest improvement, and erosion control produced considerable effects, both positive and negative, on river runoff. Annual runoff values corrected for climatic and physiographic factors for the second and third periods were 45.4 and 42.2 cu km, respectively, at the Kiev gaging station and 54.8 and 50.2 cu km, respectively, at the Lotsmanskaya Kamenka gaging station. (Cassar-FRC)
W82-06983

4D. Watershed Protection

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,
Wisconsin Univ.- Madison. Dept. of Geography.
J. C. Knox, S. J. Cary, and F. J. Magilligan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243544, Price codes: A04 in paper copy, A01 in microfiche.

Technical Report WIS WRC 81-03, 1981. 56 p, 19 Fig, 3 Tab, 62 Ref. OWRT A-079-WIS(2). 14-34-0001-8053/9053.

Descriptors: *Sediment yield, *Climatic data, *Seasonal variation, *Model studies, *Watersheds, Sediment transport, Sediment load, Sediment discharge, Sedimentary basins, Precipitation rate, Snowmelt, Environmental effects, Streams, Land use, Time series analysis, Storms, Storm runoff, *Wisconsin, *Black Earth Creek.

Variations in sediment availability were examined to assess the probable impacts of the documented environmental changes for sediment production in upper Balck Earth Creek. Analysis of the monthly sediment transport relationship permitted quantification of seasonal and within-season variations of sediment availability in response to precipitation variations. Sediment availability in the Creek (as indicated by the exponent of the regression equation describing the power functional relationship between sediment and water yields) was high in early summer, and low at other times. Monthly precipitation was negatively associated with sediment availability at all times of the growing season, except for the early spring following snowmelt. A relatively high Creek sediment production in the 1954-60 period was attributed to the frequent occurrence of large storms in late spring/early summer. The relatively low annual sediment production from 1961-65 was attributed to the shift of most large storms to the late summer months. Observed land use changes toward a greater erosion potential were less important than climatic factors for determining annual Creek sediment production between 1954-65. (Zielinski-MAXIMA)
W82-05931

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06151

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
C. T. Osborn, A. D. McQueen, and R. N. Shulstad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254947, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Bulletin 856, November 1981. 23 p, 5 Fig, 4 Tab, 8 Ref. OWRT A-056-ARK(1).

Descriptors: *Cost-benefit analysis, *Soil erosion, *Erosion control, *Watersheds, *Recreation, Cost analysis, Costs, Economic aspects, Recreation facilities, Public waters, Project planning, Forecasting, Bank erosion, Planning, Forecasting, Benefits, *Arkansas, Lake Chichot.

A study was conducted to determine the most cost effective soil erosion control program to maintain current recreational viability for the northern basin of Lake Chicot, and to establish, through benefit-cost analysis, whether such a program could be justified economically. Using mathematical approaches for estimating costs and benefits discretely, it was possible to calculate a benefit-cost ratio (b/c) for a soil erosion control program that would at least maintain the present water quality of the northern Lake basin. With a b/c ratio greater than unity representing a program economically desirable, a ratio of 112 was obtained using the consumer's surplus limiting case benefit over the present value of costs for a project life of 50 years, while a ratio of 81 was obtained using a 20-year planning horizon while retaining all other assumptions. Further, in the worst case, the b/c ratio was found to be 33. Hence, the magnitude of these b/c ratios clearly implies the high desirability of initiating a soil erosion control program from society's standpoint. Recreational benefits are by far the most significant; their preservation is the primary goal of the proposed program. (Zielinski-MAXIMA)
W82-06170

EVALUATION OF THE STREAM REACH INVENTORY AND CHANNEL STABILITY INDEX FOR INSTREAM HABITAT ANALYSIS,
Wyoming Univ., Laramie. Water Resources Research Inst.
W. H. Eifert, and A. Wesche.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256546, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series No 82, May 1982. 106 p, 13 Fig, 15 Tab, 81 Ref, 2 Append. OWRT A-033-WYO(1), 14-34-0001-1154.

Descriptors: *Channel stability, *Aquatic habitat, *Trout, *Ocular survey, Standing crops, *Wyoming, Indicators, Bioindicators, *Correlation analysis, *SRICSI methodology, Montane streams.

In 1975, the Northern Region of the U.S. Forest Service developed an ocular watershed evaluation methodology entitled 'Stream Reach Inventory and Channel Stability Index' (SRICSI). Designed to assess the physical aspects of channel and streamback stability, the SRICSI's value as an aquatic habitat evaluation technique was basically unknown. During the spring and summer of 1981, 17 representative study sites on two 2nd order montane streams were evaluated through application of the SRICSI procedure and three aquatic habitat assessment methodologies. Salmonid population estimates were also obtained for each site. Trout standing crop estimates were statistically compared to study site SRICSI scores, the results obtained from the habitat evaluation procedures, and to data collected on 63 habitat-related independent variables. Results indicate a significant relationship exists between SRICSI scores and both trout population estimates and to two of the three habitat evaluation procedures. All correlations were negative, thereby suggesting that as SRICSI scores increase, trout standing crops and subsequent habitat conditions decreases. Additionally, 40 habitat variables displayed significant correlations to trout standing crop data, with 15 selected for possible inclusion in the SRICSI. Inclusion of those variables found compatible with the SRICSI procedure should increase its biological sensitivity thereby broadening its use in aquatic habitat studies.
W82-06308

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2J.
W82-06364

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,
Army Engineer District, St. Louis, MO.
For primary bibliographic entry see Field 2J.
W82-06426

EROSION CONTROL AT A DELICATE HIGHWAY CONSTRUCTION SITE,
Oregon Dept. of Transportation, Salem.
J. H. Versteeg, and J. J. Earley.
Public Works, Vol 113, No 3, p 82-83, March, 1982.

Descriptors: *Erosion control, *Highway relocation, *Soil erosion, Construction, *Oregon, Dikes, Dams, Mulches, Channel improvement, Fish conservation, Slope stabilization, Landslides, Water quality control, Monitoring, Sediment control.

Reconstruction of a section of Interstate 5 in Oregon included several features designed to prevent adverse environmental effects during construction. To control stream turbidity heavy equipment was kept out to the stream channel as much as possible and stream crossing-sediment traps were constructed. Dikes were built to isolate construction activities from the flowing stream. Straw bales underlaid with drain rock were placed in slope gullies. Seed and straw mulch were put on slopes. Slopes were terraced to reduce soil erosion. Shrubs and willow trees were planted to control erosion and maintain cooler water temperatures. Six potential slides are being monitored so that stabilization may be undertaken if necessary. No work was done in existing streams during October 15 through June 1, so that fish spawning was not disturbed. Sediment dams and straw bale sediment barriers were installed after June 1 and were removed before October 15. Most dams trapped 8-24 inches of mud, which was cleaned out before the fall rains. Water quality, as measured by pH, dissolved oxygen, turbidity, and temperature, was within acceptable limits. Notched weirs were located in 21 sites where stream gradient and water velocity were excessive. (Cassar-FRC)
W82-06510

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
For primary bibliographic entry see Field 2J.
W82-06620

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),
For primary bibliographic entry see Field 8E.
W82-06636

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06672

SUBSURFACE DRAINAGE EFFECTS ON EROSION,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, A. A. Nassehzadeh-Tabrizi, and G. R. Foster.
Journal of Soil and Water Conservation, Vol 37, No 3, p 167-172, May/June, 1982. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Erosion control, *Subsurface drainage, Drainage, Erosion, Groundwater movement, Subsurface drains, Drains, *Model studies, *North Carolina, Goldsboro, Soil types, Sand, Loam, Surface runoff, Simulation analysis.

A computer simulation method for characterizing the effects of artificial drainage on erosion is presented, and the use of this method is demonstrated on a soil in eastern North Carolina. The drainage simulation model, DRAINMOD, was coupled with the CREAMS model for simulation erosion. Use of the coupled model was demonstrated for Goldsboro sandy loam soil. The simulation showed that erosion on Goldsboro soil with an average slope of 2% could be reduced appreciably with subsurface drainage. For example, predicted average annual rates of erosion declined by a factor of 10, from 9 to 0.9 metric tons per hectare, upon changing the drainage system from one with good surface drainage and poor subsurface drainage to one with poor surface drainage and good subsurface drainage. Subsurface drainage, therefore, should be considered as a possible best management practice for reducing erosion on relatively flat land, since it increases available profile storage and reduces surface runoff. On the negative side, intensive subsurface drainage generally increases nitrate loss from agricultural land. Whether increased loss of nitrates counteracts the beneficial effect of reducing sediment and associated nutrient and pesticide losses depends on the site and the quality of the receiving waters. Use of artificial

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drainage can significantly affect the rate and flow path of water leaving the field. (Baker-FRC)
W82-06795

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
A. D. McQueen, R. N. Shulstad, and C. T. Osborn.
Journal of Soil and Water Conservation, Vol 37, No 3, p 182-185, May/June, 1982. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Erosion control, *Farm management, *Soil loss, Erosion, North Lake Chicot, *Arkansas, Crops, Watershed management, Cost-benefit analysis, Water Quality, Water pollution effects.

The costs of alternative methods of erosion control in a specific watershed were investigated. The watershed under study was North Lake Chicot, a 5,025 acre oxbow lake created by the past meandering of the Mississippi River. While the lake at one time offered excellent fishing and other recreation, channelization and levee construction in nearby areas diverted drainage and floodwaters from about 350 square miles of agricultural land into Connerly Bayou and ultimately into Lake Chicot. A levee was constructed across the lake just north of the point where Connerly Bayou enters it. The southern basin's impact has been substantial over the ensuing years, but the northern basin remained quite clean and free of significant pollution until recently. Erosion control policies were evaluated using a linear programming model, which incorporated constraints on the amount of field equipment, irrigation equipment, and time available for agricultural production. Seven crop rotations and four management practices were evaluated. The analysis indicated that soil loss could be reduced 24% per year while increasing net revenues by 28% with proper soil management and cropping patterns. Both cover cropping and the use of an average soil loss restriction were more cost effective than the Soil Conservation Service structural plan for reducing soil erosion in the watershed. (Baker-FRC)
W82-06796

EFFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,
Allahabad Univ. (India). Dept. of Chemistry.
S. Chandra, and S. K. De.
Soil Science, Vol 133, No 4, p 228-231, April, 1982. 4 Tab, 13 Ref.

Descriptors: *Manure, *Erosion rates, *Soil stabilization, Fertilizers, *Animal wastes, Farm wastes, *Soil erosion, Erosion control, *India, Cattle, Soil texture, Bacteria, Soil bacteria, Soil amendments, Soil treatment.

Cattle manure was applied at concentrations of 1% and 2% to soils from six sites in India in a laboratory study to determine erosion coefficient at 15 and 30 days incubation. The 1% concentration decomposing for 30 days effectively reduced soil erosion. Erosion coefficients were 68.8-8.1 compared with 82.9-9.6 in untreated soils. The 2% concentration was only slightly better than the 1% concentration. At the 15 day incubation point erosion coefficients were higher than those of untreated soils. This was caused by a temporary increase in C02 and soil pH during decomposition of the manure. Manure application was more effective in light textured soils with higher erosion coefficients. The four treatments were ranked in order of efficiency: 2%, 30 days > or = 1%, 30 days > 1%, 15 days > 2%, 15 days. (Cassar-FRC)
W82-06834

APPLICATION OF SCS INFILTRATION MODEL,
S. Kumar, and S. C. Jain.
Water Resources Bulletin, Vol 18, No 3, p 503-507, June, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Infiltration, *Model studies, Rainfall, Runoff, Hydrology, Flow, Rainfall-runoff relationships, Overland flow.

Application of the Soil Conservation Service (SCS) infiltration model to the watershed of the north branch of Ralston Creek, northeast of Iowa City, Iowa, is considered. The 3.01 square mile watershed is largely rural and agricultural. It has a channel length of four miles and a drop in elevation of about 140 feet. The valley has fairly steep slopes in its southern and eastern sections, with a gently rolling configuration over the western and northwestern parts. The SCS infiltration model was modified to suit the type of rainfall data needed for predicting overland flood hydrographs. Hourly runoff and loss rates were computed using the SCS model. The precipitation in five-minute intervals was superimposed on the hourly loss rate. The hourly loss rates were then adjusted such that the volume of rainfall excess computed using five-minute data agreed with the hourly runoff predicted by the modified SCS model. A trial and error procedure was adopted to determine the curve number, AMC, and MIR for the distributed watershed. The complete distributed watershed model including the modified SCS model was tested for two storms. The results indicate that the infiltration model satisfactorily described the distribution of losses and that the technique of calculating rainfall excess hyetographs to develop overland flood hydrographs is adequate. (Baker-FRC)
W82-06872

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Water Resources Bulletin, Vol 18, No 3, p 415-421, June, 1982. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Model studies, *Sediment discharge, Sedimentation, Sediments, Mathematical studies, Erosion, Dynamics, Watersheds, Small watersheds, *Watershed management.

A dynamic system sediment discharge model based on upland erosion mechanics was developed and tested. The system model was intended to simulate sediment discharge with short time increments using simple hydrologic variables such as rainfall intensity and runoff. This would allow the model to be incorporated into hydrologic models. The model was developed from an expansion of splash and flow erosion relationships under steady state conditions. It incorporated eight parameters such as rainfall intensities, runoff rates, and previous sediment discharges. The model was tested on two small watersheds, with simulation results which were highly satisfactory relative to the data. The resulting linear model explained variations with coefficients of determination averaging 0.99. Parameter coefficients varied with storm characteristics, suggesting that the proposed model is a quasi-linear model. This leads to a conclusion that sediment discharge systems may not be properly represented by any single flow-sediment discharge relationship. The model was also tested with snowmelt events as well as with storm oriented runoff. (Baker-FRC)
W82-06876

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 8B.
W82-06959

FIRE AND GEOMORPHIC PROCESSES,
For primary bibliographic entry see Field 2J.
W82-06963

MANAGEMENT OF WATERSHED REHABILITATION-- REFLECTIONS FROM MT. ST. HELENS AND REDWOOD CREEK,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. J. Swanson, and S. D. Veirs Jr.
In: Proceedings of a Symposium on Watershed Rehabilitation in Redwood National Park and Other Pacific Coastal Areas, August 24-28, 1981, Arcata, California, Center for Natural Resource Studies, Sacramento, California, 1982, p 11-16. 1 Fig, 1 Ref.

Descriptors: *Watershed management, *Erosion control, *Cost analysis, Planning, *Political aspects, Sediments, Evaluation, Road construction, Logging, Volcanoes, Governmental interrelations, *Mount St Helens, *California, Redwood Creek.

Many major watershed rehabilitation projects begin in an uneasy, high-profile, hurried, politically charged environment. Despite differences in physical setting, ultimate objectives, and other considerations, these political factors result in a set of problems common to many watershed rehabilitation projects. Watershed rehabilitation projects at Redwood Creek, California, and Mt. St. Helens, Washington, present some instructive contrasts and similarities. Legislation expanding Redwood National Park provided for rehabilitation of lands affected by road construction and timber harvest. This project is funded for an anticipated program of 10 to 15 years, planned and conducted in part by scientists, and managed by a single Federal agency. The 1980 erruption of Mt. St. Helens, on the other hand, triggered a mix of responses by many agencies and organizations working with overlapping responsibilities in a crisis environment. Planning horizons for treating watershed problems at Mt. St. Helens have generally spanned only a matter of months to a few years, in part because funding for rehabilitation and hazard control has come in short-term allocations for specific projects. Examination of these two quite different projects reveals five criteria for successful, efficient design and execution of a large watershed rehabilitation project: state long-term and short-term objectives; use an interdisciplinary approach at all stages; consider erosion processes and fate of sediment in planning erosion control measures; define costs of full, partial, and no treatment; and provide independent evaluation of programs. (Moore-SRC)
W82-06968

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,
Humboldt State Univ., Arcata, CA., Dept. of Geology.
A. K. Lehre, B. Collins, and T. Dunne.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April, 1982, p 215-234. 6 Fig, 6 Tab, 11 Ref.

Descriptors: *Volcanoes, *Sediment erosion, *Sediment transport, *Mount St. Helens, Landslides, Mudflows, Tephra, Particle size, Aerial photography, Gravel, Sand, Silt, Mass wasting, Toutle River, *Washington.

The 18 May 1980 eruption of Mt. St. Helens greatly altered the drainage basin of the North Fork Toutle River. The lateral blast destroyed vegetation and deposited up to a meter of gravelly and sandy ash on hillslopes in 336 sq km of the drainage north and west of the mountain; subsequent airfall mantled these deposits with 0.02-0.06 m of poorly-permeable silty ash. A massive rockslide-avalanche filled 60 sq km of the upper North Fork Valley with volcanic rubble 5-195 m thick. Volcanic mudflows covered the banks and floodplain of the North Fork with 0.5-5 m of sand, silt, and gravel. Rapid erosion of these deposits has created major sediment management problems on the North Fork and its tributaries. Simple field and airphoto measurements were used to estimate the quantity and particle-size distribution of sediment contributed from each source. From June 1980-May 1981, a total of 55,000,000 cu m of sediment (35% gravel, 47% sand 18% silt/clay) was eroded in the drainage, chiefly (77%) from the debris avalanche. Between 33 and 45% of this sediment was redeposited in the system. Net sediment yield to the Main Toutle was 30,000,000 to 37,000,000 cu m, of which 39% was gravel, 46% sand, and 15% silt/clay. It is anticipated that sediment yields over the next several years will be no larger than that of the first year; yields will continue on the order of

10,000,000 to 30,000,000 cu m/yr, with the avalanche the most important source. (Moore-SRC)
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,
Washington Univ., Seattle. Dept. of Geological Sciences.
B. Collins, T. Dunne, and A. K. Lehre.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April 1982, p 82-97. 10 Fig, 7 Tab, 11 Ref. PNW-80-179.

Descriptors: *Volcanoes, *Sediment erosion, *Erosion rates, *Mount St. Helens, Tephra, Sheet erosion, Rill erosion, Sediment transport, Slopes, Vegetation, *Washington, Toutle River.

The 1980 eruptions of Mount St. Helens resulted in the widespread destruction of vegetation and deposition of 70,000,000 cu m of tephra on hillslopes covering a 352 sq km area in the drainage basin of the North Fork Toutle, South Fork Toutle, and Green Rivers. Since the eruption, these tepha and underlying colluvium have been eroded into the streams of the Toutle River System by sheet wash and rill wash. Local rates of erosion ranged between 500 and 74,500 cu m/sq km/year and were controlled by surface cover, hillslope gradient, tephra thickness, and tephra texture. During the first post-eruption year, 7,600,000 cu m of tephra and 1,300,000 cu m of colluvium eroded from the basin. These values represent erosion rates of 21500 cu m/sq km/year and 3600 cu m/sq km/year of tephra and colluvium, respectively, equivalent to a denudation of 25.1 mm/year. Thirty-one percent of all sediment eroded from hillslopes was trapped in lakes impounded by the debris avalanche that filled the North Fork Toutle River valley on 18 May 1980. Of the remaining 8,000,000 t of sediment that entered streams of the Toutle River system, 36% was clay and silt, 58% was sand, and 6% was gravel. (Moore-SRC)
W82-06971

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 5F.
W82-05932

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,
Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-05934

IDENTIFICATION OF ATYPICAL COLIFORMS FROM PUBLIC WATER SUPPLIES IN MISSOURI,
Missouri Univ., Columbia. Dept. of Civil Engineering.
S. K. Banerji, and L. Laohaviranit.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243585, Price codes: A03 in paper copy, A01 in microfiche. Report, March 1982. 17 p, 5 Tab, 16 Ref, 1 Append. OWRT A-121-MO(1), 14-34-0001-0127.

Descriptors: *Coliforms, *Pseudomonas, *Bacterial analysis, Water pollution sources, *Drinking water, Bacteria, Water analysis, *Water treatment, Contamination, Pollutants, Water conveyance, Culture media, Culturing techniques, Water pollution, Water pollution control, Water pollution treatment, Water quality, *Missouri.

Membrane filter plates containing atypical coliform colonies in water samples were obtained from Columbia and seven other Missouri manicipalities. Of the 71 pink-to-red atypical coliform colinies isolated, 94% were gram- negative rods, with the remainder being gram-negative Coccobacilli. The rods were identified as: Pseudomonas (44.8%), Enterobacter (22.3%), Klebsiella (6%), Aeromonas (4.5%), Alcaligenes (4.5%), and Citrobacter (2.9%). Those colonies unidentified included: fermetative-oxidase-positive and -negative (6% each), and nofermentative-oxidase-positive and-hegative (1.5% each) bacteria. The gram-negative Coccobacilli were classifies as either Pasteurella, Haemophilis, of Actinobacillus, due to uncertainites in the assay method. Many of these atypical coliforms have the potential of being a human/animal pathogen. Futher sutdy is needed to assess the significance of the presence of these organisms on the health of the populations served by these water supplies. Research is also needed to assess, the survival characteristics of these organisms during various water treatment operations. (Zilelinski-MAXIMA)
W82-05935

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,
Beckman Instruments, Inc., Carlsbad, CA.
A. A. Bulich.
Process Biochemistry, Vol 17, No 2, p 45-47, March/April, 1982. 6 Tab, 5 Ref.

Descriptors: *Bioassay, *Toxicity, *Industrial wastewater, Water pollution effects, Monitoring, Microtox, Fish, Daphnia, Bacteria, *Pollutant identification.

The toxicity of aquatic samples was monitored by a bioassay method (Microtox), based on changes in the light output of luminescent bacteria as measured with a photometer. A freeze dried preparation of Photobacterium phosphoreum was reconstituted, the sample was diluted to 5 concentrations from 5 to 50% and light measurements were made initially and 5 min later. LC50 was readily calculated from a formula. A total of 257 samples of wastewaters and effluents were tested. The Microtox test results agreed with in 1.5 orders of magnitude for 97.5% of fish toxicity vs. Microtox result s and 96.1% of Daphniz toxicity vs. Microtox results. The Daphnia test was more sensitive that the Microtox bioassay. The Microtox system, which requires only 30 min, provides a rapid, low cost method of monitoring effluents, screening new chemical products, and determining the toxicity of fluids prior to disposal. (Cassar-FRC)
W82-05951

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,
Genoa Univ. (Italy). Fisiologia Generale.
For primary bibliographic entry see Field 5C.
W82-05983

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,
Canada Center for Inland Waters, Burlington (Ontario).
T. Bistricki, and M. Munawar.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 506-509, March, 1982. 4 Fig, 5 Ref.

Descriptors: *Metals, *Algae, *Electron microscopy, *Pollutant identification, *Heavy metals, Diatoms, Flagellates, Phytoplankton, Chlorophyta, *Great Lakes, Bioaccumulation, Accumulation, X-ray spectroscopy.

Heavy metals were determined in samples of phytoplankton by electron microscopy combined with an energy dispersive x-ray spectrometer and a computer-based processing system. Spectra of several species showed inherent structural components as well as elevated levels of some metals. Staurastrum paradoxum, a green alga, contained elevated levels of Mn, Cu, Fe, and Al. Cyclotella sp., a diatom, contained Cu even though the water was low in Cu (2 micrograms per liter). Rhodomonas minuta, a phytoflagellate, showed peaks of Pb, Fe, Cu, and Os. These findings confirm that certain nanoplankters can be used as indicators of heavy metal pollution. (Cassar-FRC)
W82-05993

APPLICATION OF NUCLEAR DOUBLE RESONANCE TECHNIQUE FOR DETECTION OF PESTICIDES IN WATER AT LOW CONCENTRATIONS,
Institut Jozef Stefan, Ljubljana (Yugoslavia).
R. Osredkar, and P. K. Kadaba.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 513-518, May, 1982. 4 Fig, 5 Ref.

Descriptors: *Pollutant identification, *Pesticides, *Nuclear magnetic resonance, *Wastewater analysis, Carbamate pesticides, Organic pesticides, Triazine pesticides, Industrial wastes, Pollutants, Separation techniques.

The nuclear double resonance (NDR) technique was applied to the detection of organochlorine and carbamate pesticides at low concentrations in water. The method utilizes the strong nuclear magnetic resonance signal of an abundant spin system to detect the weak nuclear resonance of the spin species. Bromoform is used as solvent for the extraction of chlorinated pesticides, and chloroform is used in the case of non-chlorinated carbamate pesticides. The minimum detectable concentrations of the test compounds cabanolate, barban, CIPC, atrazine, and simazine were 20, 20, 20, 100, and 100 ppb, respectively. The NDR method in its present form is less sensitive than the electron capture gas chromatography method, but requires less elaborate clean-up and separation procedures. NDR may be used to analyze organochlorine and triazine pesticides in wastewater provided the concentration of these contaminants is between 10 and 100 micrograms/liter. In its present form, the instrument is not recommended for routine analysis. Improvements in sensitivity may be realized by using a liquid nitrogen-cooled ferrite-cored electromagnet, increasing the polarizing field, and introducing a two-magnet system. (Geiger-FRC)
W82-06004

SIMPLE PROCEDURES FOR ENRICHMENT OF CHLORINATED AROMATIC POLLUTANTS FROM FAT, WATER AND MILK FOR SUBSEQUENT ANALYSIS BY HIGH-RESOLUTION METHODS,
Karolinska Inst. Stockholm (Sweden). Dept. of Physiological Chemistry.
B. Egestad, T. Curstedt, and J. Sjovall.
Analytical Letters, Vol 15, No 3, p 293-307, 1982. 5 Tab, 26 Ref.

Descriptors: *Pesticides, *Gel chromatography, Pollutant identification, DDT, *Chlorinated hydrocarbons, *Aromatic compounds, Water analysis, Insecticides, Sample preparation, Polychlorinated biphenyls.

Lipidex 1000 and 5000, lipophilic gels, were suitable for extraction and purification of nonpolar chlorinated aromatic pollutants (DDT, polychlorinated biphenyls, and tetrachlorodibenzodioxin) in water, milk, and butter. A 1-liter water sample containing 50,000 cpm DDT labeled with C14 was passed through a 2 ml gel bed (Lipidex 1000) at the rate of 50 ml per min. Recovery of DDT by elution with 10 ml methanol was 96.6%. (Cassar-FRC)
W82-06015

HEADSPACE CHROMATOGRAPHIC DETERMINATION OF WATER POLLUTANTS,

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Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. Otson, and D. T. Williams.
Analytical Chemistry, Vol 54, No 6, p 942-946, May, 1982. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Water analysis, *Gas chromatography, Drinking water, Potable water, Organic compounds, Chemical analysis, Water quality, *Pollutant identification.

A modified purge and trap technique is presented for the evaluation of potentially hazardous volatile organics in Canadian potable water supplies. The method employs on-column trapping and simultaneous use of flame ionization and electrolytic conductivity detectors to develop a dynamic headspace gas chromatographic technique. Forty-two organics in water were evaluated, with detection limits of less than 1 microgram/liter. Linear plots of peak area against concentration were obtained in the range of 0.25-16 micrograms/liter for 32 compounds. At aqueous concentrations of 4 and 16 micrograms/liter, peak area precision of less than 10% relative standard deviation for triplicate sample analyses and purging efficiencies of greater than 75% were generally obtained. Storage of aqueous composite standard solutions at 4 and 16 micrograms/liter for 6 weeks at 4 degrees centigrade did not usually affect the analytical results by more than 15%. Poor precision of results was often due to inconsistent and inaccurate peak area integration, which generally occurred for small peaks or when peaks were closely clustered. These problems were primarily due to the fact that integration parameters were established at the start of the automated gas chromatographic analyses and could not be optimized for each sample and compound. (Baker-FRC)
W82-06016

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,
Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
H. Klimowicz.
Acta Hydrobiologica, Vol 23, No 1, p 47-67, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Zooplankton, Water quality, Water pollution effects, *Vistula River, Warsaw, *Poland, Rivers, Plankton, Wastewater pollution, Saprophytic bacteria, Species composition, Bacteria.

An investigation of plankton in a 59 km reach of the River Vistula at Warsaw, Poland, indicated a saprobity index of 1.9 for phytoplankton and 2.1 for zooplankton and a water quality class of 2, requiring treatment before consumption. The sampling was done twice a month over two annual cycles, from February 1977 to April 1979. A total of 128 plant taxa and 152 animal taxa were identified. The most common were Rotatoria (72 species), Bacillariophyta (67), Ciliata (54), Euglenophyta, (15), and Cladocera (9). The composition and numbers of plankton depended on water fertility, season, and water temperature. The same plankton species dominated the community in the same seasons of both years. Species compositions were similar above and below sewage inflow points, probably because the Vistula is deep and wide. (Cassar-FRC)
W82-06021

CONTINUOUS MONITORING OF CYANIDE CONCENTRATION IN SURFACE WATER (KONTINUIERLICHE UBERWACHUNG DER CYANID-KONZENTRATION IN OBERFLACHENWASSER),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
F. Dietz, H. D. Frank, and G. Teske.
Wasser, Luft und Betrieb, Vol 26, No 1/2, p 17-21, 1982. 6 Fig, 2 Tab, 15 Ref. (No English summary).

Descriptors: *Cyanide, Surface water, *Monitoring, Pollutants, Rivers, Potassium compounds, Heavy metals, Cadmium, Copper, Zinc, On-site investigations, Laboratory equipment, Potentiostatic measurement, *Federal Republic of Germany, *Ruhr River, *Pollutant identification.

The potentiostatic method of Schwarz and Simon for the continuous monitoring of cyanide concentrations in water was tested in the laboratory for accuracy and, following successful results, in situ on the bank of the Ruhr River in the Federal Republic of Germany. With this method, the substance to be measured does not participate in the charge exchange on the measuring electrode but reacts with the metal ions of the electrode (in this case, cyanide reacts with silver). The apparatus used in the method is the DIGOX CN-2. Distilled water was used as a control. Ruhr water with an added concentration of 50 micrograms CN/;iter was tested, and the DIGOX CN-2 registered 76% of potassium cyanide compared with control, all cyanide in copper, zinc, and cadmium complexes, but only 4-7% in nickel complexes; registering of cyanide-iron complexes was expectedly low. Results showed that the added cyanide ions were not taken up by heavy-metal solutions even after several days. In situ, the apparatus was set up in a guage station. The efficiency of the system was tested by dosing the analysis block with a solution of 50 micrograms CN/liter with a stabilized solution of 500 micrograms/liter potassium cyanide. The solution was practically unchanged after a week. The practicalities of setting up and maintaining the system are discussed. (Gish-FRC)
W82-06023

ON THE LIMITS OF DETECTION OF TRACES OF VOLATILE ORGANICS IN WATER, USING AMBERLITE XAD-2 RESIN,
La Trobe Univ., Bundoora (Australia). Dept. of Physical Chemistry.
R. Care, J. D. Morrison, and J. F. Smith.
Water Research, Vol 16, No 5, p 663-665, May, 1982. 2 Tab, 16 Ref.

Descriptors: *Ion exchange, *Organic compounds, *Detection limits, *Pollutant identification, Resins, Trace levels, Hydrocarbons, Water analysis, Amberlite XAD-2 resin.

XAD-2 resin proved unsuitable for detection of very low levels of organic compounds in water. In blank Experiments the well-cleaned resin continued to emit trace amounts (0.1-1 ppb) of toluene, styrene, benzene, undecane, and substituted benzenes when extracted with diethyl ether. The source of the hydrocarbons may be breakdown of the resin or residues from breakdown under the Soxhlet cleaning procedure. (Cassar-FRC)
W82-06028

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,
National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen, and A. Malherbe.
Water Research, Vol 16, No 5, p 745-748, May, 1982. 3 Fig, 16 Ref.

Descriptors: *Wastewater analysis, *Organic compounds, *Pollutant identification, Gel permeation chromatography, Activated sludge process, Organic carbon.

Determination of molecular mass distribution of dissolved organic carbon in wastewater effluent by gel permeation chromatography produced serious errors. About 57% of the dissolved organic carbons were in the undefined region spread over 90 fractions, many of which contained sub-milligram quantities of organic carbon. The largest error was produced by background interference from the gel column. (Cassar-FRC)
W82-06030

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
J. L. Slabbert, and W. S. G. Morgan.
Water Research, Vol 16, No 5, p 517-523, 1982. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Bioassay, *Oxygen uptake, *Toxicity, *Pollutant identification, Water pollution effects, Tetrahymena pyriformis, Protozoa, Water analysis, Industrial wastewater, Ammonium, Cadmium, Copper, Cyanide, Lead, Mercury, Parathion, Pentachlorophenol, Phenol, Zinc.

The respiratory response of the protozoan, Tetrahymena pyriformis, was used in a bioassay procedure to detect toxic substances. The simple technique produced results within 10 min. Oxygen uptake rates of the organisms in test solutions were compared with that of the control, 7.2% per min. Minimum concentrations in mg per liter of the toxic substances detectable by this method were: ammonium-N, 270-275; cadmium, 0.1-0.5; copper, 0.1-0.5; cyanide, 0.013-0.014; lead, 0.001-0.01; mercury, 0.1-0.5; parathion, 0.01-0.05; pentachlorophenol,0.005-0.01; phenol, 85-90; and zinc, 0.1-0.5. Although this method is not sensitive enough to detect most substances at the levels used in drinking water standards, it is suitable for monitoring industrial effluents. (Cassar-FRC)
W82-06032

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol 16, No 5, p 551-557, May 1982. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Organic compounds, *Phenols, *Aromatic compounds, *Pollutant identification, Water pollution sources, *Fate of pollutants, *Tokyo, Japan, Organic acids, Phenolic acids.

Samples of polluted river waters in the Tokyo area and unpolluted river, brook, reservoir, and pond waters from the Ogasawara (Bonin) Islands were analyzed for phenols and aromatic acids. The phenolic acids (p-hydroxybenzoic, vanillic, syringic, p-coumaric, and ferulic acids) and o- and m-hydroxybenzoic acids were found at concentrations of < 1 micrograms per liter in both polluted and unpolluted waters. The major sources of the phenolic acids were vascular plants and their detritus. Pentachlorophenol, Bisphenol A, and terephthalic and trimesic acids, found in polluted waters but not in unpolluted waters, were attributed to human activity (pesticides, industrial wastes). The ratios of p-coumaric and ferulic acids exressed as carbon/total organic carbon and the ratios of these acids expressed as carbon/extractable organic carbon with ethyl acetate suggest that the contributions of vascular plants to polluted and unpolluted waters are not nearly equal. Ratios of syringic acid (not found in most gymnosperms) to vanillic acid were higher in polluted waters, indicating a smaller contribution of angiosperms relative to gymnosperms in polluted waters than in unpolluted waters. (Cassar-FRC)
W82-06033

INFLUENCE OF TEMPERATURE AND TIME OF INCUBATION ON THE ESTIMATION OF BACTERIAL NUMBERS IN TROPICAL SURFACE WATERS,
Singapore Univ. Dept. of Microbiology.
W. C. Jen, and R. G. Bell.
Water Research, Vol 16, No 5, p 601-604, May, 1982. 2 Fig, 13 Ref.

Descriptors: *Bacterial analysis, *Incubation, *Temperature effects, *Pollutant identification, Tropical regions, Water analysis, Heterotrophic bacteria, Singapore.

An incubation regime of 30 C for 72 hours was recommended as a standard procedure for Aerobic Plate Counts of bacteria in warm tropical surface waters. This conclusion was reached after statistical analysis of results from incubation experiments

on water samples collected from a flowing storm drain in Singapore, April-September 1980. Samples were incubated at 20, 25, 20, 35, and 40 C for periods of 24, 48, 72, 96 and 120 hours. Using a reference point of 20 C and 120 hours incubation, the 30 C regime had 120% of the cumulative plate counts, 25 and 35 C had about 95%, and 40 C had about 50%. All temperature curves leveled off at or before 72 hours. The results are consistent with the knowledge that bacteria in the tropics are well adapted to growing at 18-30 C. (Cassar-FRC)
W82-06037

DETERMINATION OF PHOSPHATE IN WASTEWATER BY ION-EXCLUSION CHROMATOGRAPHY WITH FLOW COULOMETRIC DETECTION,
Government Industrial Research Inst., Nagoya (Japan).
K. Tanaka, and T. Ishizuka.
Water Research, Vol 16, No 5, p 719-723, May, 1982. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Phosphates, *Wastewater analysis, *Chromatography, Ion exchange, Ion exclusion chromatography, *Pollutant identification, Resins, Industrial wastewater.

Phosphates were determined in wastewater samples by ion exclusion chromatography on a cation exchange resin in H+ form by elution with acetone-water. A flow coulometric detector was more effective than a conductometric detector. The chemical reaction of H+ ion formed from H3PO4 and p-benzoquinone was monitored at a constant applied potential (+0.45V vs. Ag-AgI). Reasonable separation of phosphate from coexisting strong acid ions (chloride, sulfate, and nitrate) and carbonate was attained by elution with 60% (v/v) acetone-water. The calibration graph with the flow coulometric detector was linear over the concentration range 1-150 ppm. Results of analysis of influents and effluents from domestic and industrial wastewater samples by the present method and by the molybdenum blue method showed excellent agreement. (Cassar-FRC)
W82-06040

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5D.
W82-06048

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,
Central Electricity Research Labs., Leatherhead (England).
For primary bibliographic entry see Field 2K.
W82-06052

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. E. McIntyre, and J. N. Lester.
Environmental Pollution, Series B, Vol 3, No 3, p 225-230, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Organic compounds, *Sludge, Pollutant identification, Water pollution sources, Industrial wastes, Pesticides, *Insecticides, *Organochlorines, *Polychlorinated biphenyls, England, *Path of pollutants.

A study was undertaken to assess the magnitude and range of polychlorinated biphenyl (PCB) and organochlorine insecticide (OCL) concentration in a representative sample of British sewage sludges and to consider the possible implications of the results of sewage sludge disposal options. Grab samples of sludges from primary, mixed primary, and digested treatment stages were collected from forty sewage treatment works in England, covering seven Water Authority areas. The method of analysis involved solvent extraction with hexane, cleanup by alumina/alumina-silver nitrate column chromatography, fractionation of PCB and OCL on a silica gel column, and analysis by electron capture gas-liquid chromatography. PCB concentrations appear to have diminished in England since 1970. Concentrations of lindane, DDE and dieldrin were found to be in the low microgram/gram range or less. Possible sources of these micropollutants in sewage and sludges are discussed. Dieldrin has been used both in industry as a mothproofing compound for woollen products and in agriculture as a pesticide, but its use has recently been restricted. Lindane is used in industry and in the home for wood preserving in insecticidal formulations in addition to its agricultural use. (Baker-FRC)
W82-06081

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Landsberger, R. E. Jervis, R. Lecomte, P. Paradis, and S. Monaro.
Environmental Pollution, Series B, Vol 3, No 3, p 215-223, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Sulfur, *Snow, *Pollutant identification, Monitoring, *X-ray emission, Chemical analysis, Montreal, Canada, Path of pollutants.

This paper reports the use of PIXE techniques in the quantitative determination of the total sulfur concentration in snow from the highly industrialized city of Montreal. Proton induced X-ray emission (PIXE) employs a proton beam of 1.6 MeV to bombard the targets. A simple pre-concentration technique enabled the method to achieve detection limits as low as 19 ng/g for total sulfur concentration in snow. An overall precision of 10% was achieved. Snow samples were gathered over a 24-hr period at four different locations around the perimeter of the island of Montreal. The latter part of February 1979 was chosen as the time to obtain the maximum amount of undisturbed snow in a single season. The northwest site, which is generally perceived as a less polluted area, had a sulfur concentration less than three times lower than the southeast site. The southeast site had shown one of the highest detectable amounts of sulfur dioxide in an earlier study. The PIXE method is recommended as a convenient, non-destructive technique for rain, lake or river water analyses. (Baker-FRC)
W82-06082

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,
Ben-Gurion Univ. of the Negev, Geersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 3, p 333-346, June, 1980. 4 Tab, 5 Fig, 14 Ref.

Descriptors: Wastewater, *Recycling, *Ion exchange, Cost analysis, Desalination, Municipal effluent, Water reuse, Wastewater treatment.

Recycling of waste water by ion exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime flocculation, served as a feed for the ion-exchange system. Partial desalinatin was achieved by allowing part of the feed to bypass the strong acid cation exchanger. The salt concentration was decreased from 15meq/1 (750 ppm as CaC03) to 7-10 meq/1 (350-500 ppm as CaCO3) and the organic matter, from 70-100 mg /1 COD (Chemical oxygen demand) to about 25 mg/1. The leakage of organic matter in the partial desalination mode was somewhat higher than that found in complete desalination. The resins were found to be highly resistant to an attack of organic matter over a period of one year. Three possible resin arrangements were investigated, and a cost analysis for one of them is presented. Since inexpensive chemicals, such as H2SO4 and Ca(OH)2, can be used for regeneration the system provides an economical method for recycling waste water for industry and agriculture. (Balaban-Boston)
W82-06117

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243619, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 29, September 1981. 47 p, 8 Fig, 8 Tab, 49 Ref, 1 Append. OWRT A-012-GUAM(1), 14-34-0001-9012.

Descriptors: *Diatoms, *Water analysis, *Bioindicators, *Microscopic analysis, Water sampling, Nitzschia, Gomphonema, Water quality, Impaired water quality, Aquatic life, Aquatic populations, Urban runoff, *Indicators, Nutrient requirements, Nutrients, Nitrates, Phosphates, *Guam, Periphyton, *Pollutant identification.

Periphytic diatoms were collected on immersed glass slides in five bodies of polluted/unpolluted freshwater for 10-14 days, concomitant to the collection of water samples on three separate days. The water samples were analyzed for 22 water quality parameters. Natural surfaces (plants, rocks, sediments) were also sampled for comparison of inhabitant diatom assemblages with the glass slide collections. Data from counting at least 750 diatom frustules on randomly-selected slide areas were used to calculate species diversity indices, a sample similarity index, and to determine whether diatom assemblages occur according to water quality or habitat type. Bodies of water from urban runoff had diatoms dominated by Nitzschia palea and low species diversity, particularly where nutrient (nitrate and phosphate) enrichment occurred. Gomphonema parvulum diatoms dominated ponded habitats where mineral nutrients were excessively low (below 0.020 mg/liter). High sample similarity between river stations over time indicated that district diatom assemblages exist accordig to water quality and habitat type. It was also noted that less diatom species numbers (over 33%) and species diversity occurred on the slides than on the natural substrata samples. (Zielinski-MAXIMA)
W82-06146

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W82-06158

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5C.
W82-06168

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W82-06169

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ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,
Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5D.
W82-06178

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
M. Silva, and M. Valcarcel.
Analyst, Vol 107, No 1274, p 511-518, May, 1982. 2 Fig, 5 Tab, 37 Ref.

Descriptors: *Copper, *Water analysis, *Pollutant identification, *Atomic absorption spectrometry, Heavy metals, Trace metals, Analytical techniques.

This paper describes a sensitive method for the determination of trace amounts of copper by atomic absorption spectrometry after extraction using 1,2-naphthoquinone (NQT) and isobutyl methyl ketone (IBMK). The NQT complex is stable in IBMK medium. The method has been successfully applied to the determination of copper in water, food and analytical reagents. By this method copper concentrations in the nanogram per milliliter range can be determined. It is possible to extract the complex over a wide range of acidities, and the complex is very stable in IBMK solution. In most instances the method offers a greater sensitivity for the determination of copper. The coefficient of variation is generally smaller than that found in other determinations. By the NQT method, higher ratios of foreign ions can be tolerated than is the case when other reagents are used. By extraction into IBMK the formation of toxic products in the flame is avoided. (Baker-FRC)
W82-06179

DETERMINATION OF SULPHIDE IN INDUSTRIAL WASTE WATERS AND SEWAGE WATERS WITH AN IODIDE-SELECTIVE ELECTRODE,
Sofia Univ. (Bulgaria). Faculty of Chemistry.
M. Novkirishka, G. Michailov, and R. Christova.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 305, No 1, p 411-412, March, 1981. 1 Tab, 2 Ref.

Descriptors: *Sulfides, *Pollutant identification, *Industrial wastes, Sewage, Chemical analysis, Water analysis, Iodometry, Potentiometers, Photometry, *Leather industry.

The sulfide content in leather industry waste waters and in sewage waters was determined in order to apply an indirect potentiometric method for the determination of sulfide by means of an iodide ion-selective electrode. The results obtained were compared with those obtained by means of standard methods such as photometry with dimethyl-n-phenylenediamine and iodometry. The reproducibility of the potentiometric method was similar to that of the photometric one. The standard deviation of both methods is of the same order of magnitude. The photometric method could not be applied to the determination of sulfides in sewage water, as their concentration is close to the detection limit. The iodometric method could not be used for these samples, as its sensitivity is quite poor and it has a high blank. The potentiometric method with the iodide ion-selective electrode was very fast, about 30 minutes per analysis, sensitive at 0.02 mg/liter, and reproducible. The method applied, using sulfide separation from the interferences, can be used for the determination of sulfides in samples with various and complex composition. (Baker-FRC)
W82-06192

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7C.
W82-06233

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,
CH2M/Hill, Atlanta, GA.
J. C. Nemeth, and T. H. Eck.
Tappi, Vol 65, No 5, p 171-175, May, 1982. 2 Fig, 8 Ref.

Descriptors: *Baseline studies, *Environmental effects, Case studies, *Bioindicators, *Pulp wastes, Data collections, Benthos, Water pollution effects, Pulp and paper industry, Industrial wastes, Physical properties, Water properties, Chemical properties, Water quality, *Georgia, Oconee River.

Site-specific baseline biological studies in receiving waters of pulp and paper mill effluents provide the basis for logical, non-inferential comparison of before-and after conditions. They also allow more efficient environmental impact studies for obtaining permit renewal and /or facility-expansion permits. A pre-operational aquatic biology study should include seasonal records on biotic factors, especially indicator organisms such as benthic macroinvertebrates, periphyton, and fish, and physical factors such as dissolved oxygen, air and water temperature, conductivity, pH, discharge rate and stage elevation and tape-down. The study plan for baseline data collections on the Oconee River near Dublin, Georgia, at a site which would receive discharge from a newly planned paper mill is described. In this case study, the information gained was adequate to characterize the existing quality of the water at a relatively low cost. (Geiger-FRC)
W82-06235

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,
Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5C.
W82-06267

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,
Northern Michign Univ., Marquette. Dept. of Chemistry.
D. L. Macalady, C. P. Granlund, J. G. Granlund, and S. L. Vervacke.
Water Research, Vol 16, No 7, p 1277-1283, July, 1982. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Iron, *Water analysis, Surface waters, Lakes, Rivers, Chemical analysis, Colorimetry, Measuring instruments, Pollutant identification.

Iron(II) analyses were conducted on oxygenated surface waters using bathophenanthroline. In the presence of dissolved, colloidal or complexed iron(III), the BPN method for iron(II) analysis employing pH values lower than 6.5 at extraction will unavoidably overestimate the concentration of iron(II) by a small but significant amount. The interference will increase dramatically as the pH at extraction is lowered. This potential for error must be added to results reported previously which were ascribed to the reduction of iron(III) under the influence of sunlight, acid and/or dissolved organic matter. A plausible explanation for this additional interference is the formation in the presence of $FeOH(2+)$ of a complex which is spectroscopically similar to the BPN-iron(II) complex. The variable magnitude of this interference can therefore be ascribed to the presence of variable amounts of ferrous hydroxide in natural waters. This depends on the pH, the levels of colloidal iron(III) and organically complexed iron(III), and the analytical conditions used. These findings cast serious doubt on earlier claims made in the literature that measurable levels of ferrous iron and higher levels of acid digestible ferrous iron exist in the oxygenated surface waters of lakes. Several interferences from ferrous hydroxide in colorimetric analyses for iron(II) might also be expected using other complexing agents. (Baker-FRC)
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,
Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, J. M. Foght, and D. W. S. Westlake.
Water Research, Vol 16, No 7, p 1285-1290, July, 1982. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Mineralization, *Microorganisms, Lakes, Rivers, Surface water, *Monitoring, Fate of pollutants, Organic compounds, Biodegradation, Wastewater, *Pollutant identification.

A method is described for monitoring the mineralization of compounds in aqueous samples. In this method aliquots of both headspace gas and culture liquid were removed for analysis at various times. A single culture flask whose headspace gas was flushed periodically could not be used, since any carbon dioxide present is partitioned between the gas and liquid phases. The culture flask used contains 200 ml of sample with labeled substrate, and one control-replacement flask is readied with 200 ml of sterile sample with labeled substrate. At each sampling time, 1/40th of the liquid and headspace gas was removed from the culture flask for 14-CO2 recovery. This method was used to study mineralization of amino acids, starch, n-hexadecane and anthracene by microorganisms in river water, and of n-hexadecane and n-hexadecanoic acid by microorganisms in sewage effluent. To obtain a reasonable evaluation of the mineralization ability of an aquatic environment, representative samples must be subjected to the chosen analytical procedure, and the larger the sample volume, the more reliable the evaluation will be. The need for a larger sample volume is particularly important when dealing with unpolluted aquatic environments which have low densities of heterotrophic bacteria. (Baker-FRC)
W82-06272

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2K.
W82-06273

DETERMINATION OF ORGANOCHLORINES IN RIVER SEDIMENT BY CAPILLARY GAS CHROMATOGRAPHY, APPLICATION TO DUTCH RIVER SEDIMENT,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
R. C. C. Wegman, and A. W. M. Hofstee.
Water Research, Vol 16, No 7, p 1265-1272, July, 1982. 6 Fig, 5 Tab, 11 Ref.

Descriptors: *Water analysis, *Gas chromatography, Sediments, *Organochlorines, Rivers, *Netherlands, Organic compounds, Chemical analysis, *Pollutant identification, Monitoring.

Studies were conducted to develop a reliable method for the determination of a great number of organochlorines, including analyses in the presence of interfering PCBs and other co-extractives in river and harbor basin sediment. As an example of the practical application of this method, the results of a monitoring program in river and harbor basin sediment in the Netherlands are given. The sediment sample was shaken twice with acetone, followed by water partitioning. The decanted water-acetone phase was extracted twice with petroleum ether. Recoveries with this method were carried out for clay soil, peat soil and river sediment. Mean recoveries and SD of 15 organochlorines were determined. The recoveries for compounds C-601 and C-773, by-products of the aldrin and dieldrin synthesis, were only determined in river sediment 7 days after spiking and were 90% for both compounds. In the period 1979-1980 water samples from Boven Merwede and Lake Ketelmeer were

analyzed for 17 different organochlorines. Only HCB, alpha-HCH and gamma-HCH were found. The mean concentrations for the three were 0.09, 0.02 and 0.06 micrograms/liter in both water bodies. (Baker-FRC)
W82-06274

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
For primary bibliographic entry see Field 5F.
W82-06278

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W82-06280

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 4B.
W82-06309

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,
Foras Forbartha, Dublin (Ireland).
L. J. Lennox, and M. J. Flanagan.
Water Research, Vol 16, No 7, p 1127-1133, July, 1982. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Water analysis, Measuring instruments, Organic compounds, Industrial waste, Natural waters, *Kjeldahl procedure, *Pollutant identification.

A method of analyzing large numbers of samples accurately with the minimum amount of inconvenience is presented for determining total Kjeldahl nitrogen in surface fresh waters and organic wastes. The method calls for the conversion of organic nitrogen compounds to ammonium sulfate by a catalytic (red mercuric oxide) acid-sulfate digestion. The digestion time is 3 hr and allows a maximum of 36 samples, 2 blanks, and 2 standards to be processed simultaneously. No pH adjustment is required after the digestion. Calibration curves covering the ranges of 0.5 - 100 micrograms ammonium-nitrogen/liter and 10-1000 micrograms ammonium-nitrogen/liter were linear within 2%. The detection limit of the method was 0.5 micrograms total Kjeldahl nitrogen/liter. The concentration range of TKN for which the method is usable is 0.5 micrograms nitrogen/liter to 30 mg nitrogen/liter. The method displays a high tolerance to interferences from copper, iron, mercury and hardness. The digestion procedure gave a high recovery and reproducibility over a wide range of nitrogen compounds tested. The digestion procedure requires no supervision while in progress, and the colorimetric step for the determination of ammonia using a continuous flow method proceeds at a rate of 60 samples per hour. (Baker-FRC)
W82-06314

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,
Canviro Consultants Limited, Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W82-06392

ANALYSIS OF GEOTHERMAL WATERS BY SPARK SOURCE MASS SPECTROMETRY,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
R. Vandelannoote, W. Blommaert, R. Gijbels, and R. Van Grieken.
Fresenius Zeitschrift fur Analytische Chemie, Vol 309, No 4, p 291-294, 1981. 2 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Mass spectroscopy, *Trace elements, *Thermal water, Water analysis, Geothermal resources, Trace metals, Heavy metals, Thermal springs, Neutron activation analysis.

The analysis of trace elements in geothermal waters by the time consuming but sensitive method of spark-source mass spectrometry (SSMS) is described. To collect elements having quite different chemical properties such as alkalies, transition elements, and elements occurring in anionic form, a physical preconcentration step is recommended. Chemical preconcentration is carried out by cocrystallization on 1-(2-pyridylazo)-2-naphthol or chelation by 8-hydroxyquinoline followed by adsorption onto activated carbon. The relative sensitivity factors appear to be independent of the salt content of the graphite electrodes, but the precision of SSMS is slightly poorer than that obtained for neutron activation. However, SSMS has a more uniform elemental sensitivity and allows for the determination of elements for which neutron activation is not suitable, such as lead and tin. (Geiger-FRC)
W82-06464

DETERMINATION OF METHOMYL AND METHOMYL-OXIME IN FRUIT CROPS AND WATER BY HPLC,
Tieraerztlichen Hochschule, Hanover (Germany, F.R.). Chemical Inst.
M. A. Alawi, and H. A. Russel.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 309, No 1, p 8-12, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Insecticides, *High performance liquid chromatography, *Methomyl, Separation techniques, Water analysis, Carbamate pesticides, Pesticides, Pesticide residues, *Chromatography, Fruit crops.

A simple and specific quantitative high performance liquid chromatography (HPLC) technique for determining methomyl residues in water and fruit samples is described. Extraction is done with ethyl acetate, and HPLC separation is carried out on a reversed phase column with ultraviolet (UV) detection. The method allows simultaneous detction of methomyl and its degradation product, methomyl-oxime. Using a combined detection system of UV- and electrochemical detectors in series, methomyl could be determined at the 1 nanogram/milliliter level and methomyl-oxime at the 100 picogram/milliliter level in water. The recovery rate in the range of 0.01-1 micrograms/gram was 101.4 plus or minus 6% in fruit crops (apples) and 93.7 plus or minus 4% in water. (Geiger-FRC)
W82-06466

NEW HIGH-PERFORMANCE ANALYTICAL PROCEDURE FOR THE VOLTAMMETRIC DETERMINATION OF NICKEL IN ROUTINE ANALYSIS OF WATER, BIOLOGICAL MATERIALS AND FOOD,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Dept of Chemistry.
B. Pihlar, P. Valenta, and H. W. Nurnberg.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 307, No 5, p 337-346, 1981. 8 Fig, 4 Tab, 35 Ref.

Descriptors: *Nickel, Water analysis, *Metals, *Heavy metals, *Pollutant identification, *Voltammetry.

Trace levels of nickel were determined in water, wastewater, and other materials by voltammetry. DC or differential pulse voltammetry was applied after prior interfacial accumulation by an adsorption layer of dimethygloyoximate at the hanging mercury drop electrode. In aqueous media as little as 1 ng per lier of Ni may be detected with good precision and accuracy. The pretreatment for natural water involved filtration of particulate matter; ultraviolet irradiation to release heavy metals bound to organic matter; determination of Cu, Pb, Cd, and Zn in acid solutions; determination of Ni and Co after neutralization with 0.5 ml of 4M ammonia-ammonium chloride buffer, and addition of 20 microliters of 0.1 M dimethylglyoxime to a 20 ml sample. Nickel levels (in micrograms per kg) in some aqueous samples were 0.187 in a tap water; municipal wastewater, 1.49; municipal wastewater effluent, 3.96; and rain water at Dortmund, Germany, 4.73. (Cassar-FRC)
W82-06467

A RAPID HIGH-PERFORMANCE LIQUID-CHROMATOGRAPHIC METHOD FOR SIMULTANEOUSLY DETERMINING THE CONCENTRATIONS OF TFM AND BAYER 73 IN WATER DURING LAMPRICIDE TREATMENTS,
Fish and Wildlife Service, La Crosse, WI.
V. K. Dawson.
Canada Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 778-782, May, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Chromatography, *Lampricides, High performance liquid chromatography, Water analysis, Pesticides, Lamprey, Spectrophotometry, Pesticides, *TFM, *Bayer 73.

A high-performance liquid-chromatography (HPLC) method was developed for detecting as little as 0.005 milligram/liter of 3-trifluoromethyl-4-nitrophenol (TFM) and Bayer 73 lampricides simultaneously in water. The procedure requires only minutes per sample and is specific. A combined buffer and internal standard reagent is added to the water sample, which is then injected through a Sep Pak C18 disposable cartridge. The cartridge adsorbs and retains both the lampricides and the internal standard. Elution with methanol provides cleanup and concentration of the sample before HPLC analysis on an MCH 10 reverse phase column. A methanol:acetate buffer acts as the mobile phase at 2 milliliter/min and detection occurs by ultraviolet spectrophotometry at 330 (or 254) nanometers. A microprocessor data system quantifies off-scale peaks and gives results directly in milligram/liter. (Geiger-FRC)
W82-06495

EVALUATION OF COLIPHAGE DETECTION AS A RAPID INDICATOR OF WATER QUALITY,
Atlantic Research Corp., Alexandria, VA.
R. S. Wentsel, P. E. O'Neill, and J. F. Kitchens.
Applied And Environmental Microbiology, Vol 43, No 2, p 430-434, February, 1982. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Bioindicators, Water quality, *Coliforms, Bacteriophage, *Coliphage, Bacterial analysis, Microbiological studies, *Pollutant identification.

Thirteen water quality laboratories throughout the United States participated in a program to evaluate the effectiveness of ARCAT (a rapid coliphage analysis technique) in enumerating coliphages in natural waters and to verify correlations between coliforms and coliphages in these water systems. Water samples were analyzed for fecal and total coliforms and for coliphages detected by the broadrange Escherichia coli C host. The data were analyzed statistically to determine whether a relationship existed between fecal or total coliforms and coliphages. A linear relationship was found to exist between coliphages detected with the E. coli C host and fecal or total coliforms. These correlations were highly significant. These study results demonstrate that the ARCAT procedure provides a rapid, inexpensive means for enumerating coliphages in waters containing at least six coliphages per 100 milliliters within 6 hours. The coliphage levels can then be related to coliforms to give a quick indication of the number of coliform bacteria in potentially contaminated waters. The sensitivity of the test must be improved before it can be used for potable water systems. (Carroll-FRC)
W82-06537

DETERMINATION OF THE NUMBER OF RESPIRING THIOBACILLUS FERROOXIDANS CELLS IN WATER SAMPLES BY USING COMBINED FLUORESCENT ANTIBODY-2-(P-IO-

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DOPHENYL)-3-(P-NITROPHENYL)-5-PHENYLTETRAZOLIUM CHLORIDE STAINING,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. H. Baker, and A. L. Mills.
Applied and Environmental Microbiology, Vol 43, No 2, p 338-344, February, 1982. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Population density, *Bacteria, *Microbiological studies, *Fluorescence, Respiration, Chloride, Phenols, *Bacterial analysis, Natural waters, *Standing crops, *Pollutant identification.

Direct counting of microbial cells stained with fluorescent dyes is a commonly used method for determining the total standing crop of microorganisms in natural habitats, but it cannot differentiate specific types of bacteria nor distinguish between live and dead cells. The reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyltetrazolium chloride (INT) to extractable formazan has been shown to be correlated with oxygen uptake and respiratory activity. A simple method has been developed for combining fluorescent antibody staining and INT reduction to determine the numbers of viable Thiobacillus ferrooxidans cells in aquatic habitats. The procedure, called FAINT, provides a rapid, accurate measure of species-specific numbers of active cells and is more sensitive than conventional cultural techniques by at least one order of magnitude. The technique was used to investigate the distribution of T. ferrooxidans in both acidic and nonacidic sites. Comparisons among the FAINT technique and fluorescent antibody staining alone or most-probable-number determinations in 9K broth showed that the use of most-probable-number techniques resulted in an underestimation of the number of viable cells by one to three orders of magnitude, while the fluorescent antibody counts resulted in overestimation of the number of viable cells. The amount of difference varied with the sample site. (Carroll-FRC)
W82-06542

FRACTIONATION OF METAL FORMS IN NATURAL WATERS BY SIZE EXCLUSION CHROMATOGRAPHY WITH INDUCTIVELY COUPLED ARGON PLASMA DETECTION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, P. F. Landrum, and D. A. Yates.
Analytical Chemistry, Vol 54, No 7, p 1196-1198, June, 1982. 2 Fig, 16 Ref.

Descriptors: *Metals, *Magnesium, *Calcium, *Pollutant identification, Water analysis, *Chromatography, Trace metals, Chelation, Chemical analysis, Separation techniques.

Distilled water size exclusion chromatography with inductively coupled argon plasma detection was used to fractionate and measure forms of dissolved metals in natural water filtrates. Chromatograms for Ca and Mg showed three peaks each, suggesting the existence of three forms of each metal (possibly two associated with dissolved organic matter and the third with metal carbonates) in the samples of Grand River and Lake Michigan waters. The separation mechanisms involve both molecular size and component polarity. For example, hydration enlarges molecular size. The type and size of the complexing anions also influence the fractionation behavior. (Cassar-FRC)
W82-06545

AMES SALMONELLA MUTAGENICITY ASSAYS ON WATER: DICHLOROMETHANE EXTRACTS VERSUS PREPARATION OF GROWTH MEDIA WITH TEST SAMPLES,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, W. O. K. Grabow, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 641-646, June, 1982. 2 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Assay, *Testing procedures, *Sensitivity analysis, *Drinking water, bioassay, Water analysis, Secondary wastewater, Activated sludge, Separation techniques, Membrane filters, Humus sludge.

A direct method of preparing water samples for use in Ames Salmonella/microsome mutagenicity assays uses samples filtered through a membrane before mixing with agar to prepare the bottom agar layer for plate incorporation assays. This technique was compared to a procedure of testing dichloromethane liquid-liquid extracts of settled sewage, humus tank effluent, activated sludge effluent and tap water samples. Results showed that in the direct test method, much smaller volumes of test samples are required, while time-consuming, expensive and complex extraction procedures are eliminated. When settled sewage and secondary treated wastewater were used, the direct test method proved more sensitive than the extraction test method because it yielded positive results more often and was not affected by toxic constituents. Although it could not match the sensitivity of the tests on highly concentrated extracts, and may be sufficient for screening drinking water supplies. (Geiger-FRC)
W82-06548

DETERMINATION OF ALDICARB RESIDUES IN WATER BY COMBINED HIGH PERFORMANCE LIQUID CHROMATOGRAPHY MASS SPECTROMETRY,
Environmental Protection Agency, Research Triangle Park, NC.
L. H. Wright, M. D. Jackson, and R. G. Lewis.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 740-747, June, 1982. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Pollutant identification, *Mass spectrometry, *Carbamate pesticides, *High performance liquid chromatography, *Aldicarb, Separation techniques, *Chromatography, Pesticide residues, Water analysis.

A rapid and sensitive method for the determination of aldicarb, aldicarb sulfoxide, and aldicarb sulfone by a method based on combined liquid chromatography/mass spectrometry (LC/MS) is described. Analytical standards were extracted with dichloromethane and dried by passage through a glass wool/sodium sulfate column. After drying, the column was rinsed with hexane; the rinse was combined with the extracts, and the whole sample was reduced to about 0.5 milliliters under a stream of dry nitrogen before reconstitution to 5 milliliters by the addition of hexane. The extracts were refrigerated until LC/MS analysis, when they were reduced to 1.0 milliliters under a stream of liquid nitrogen. Average recoveries were 57% for aldicarb, 110% for aldicarb sulfone, and 101% for aldicarb sulfoxide. MS compares favorably with other detectors in terms of sensitivity, and the selectivity of the MS and minimum cleanup time required are added advantages. (Geiger-FRC)
W82-06549

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

AN INTRODUCTORY STUDY OF SEASONAL VARIATION IN THE AEROBIC HETEROTROPHIC BACTERIAL POPULATION OF THE SAINT JOHN RIVER USING CLASSICAL SYSTEMATICS,
M. J. Chalifour, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 16-23, Tab, Fig.

Descriptors: *Saint John River, *Aerobic populations, *Heterotrophic bacteria, Study, Enzyme activity, Seasonal factors, Alcaligenes, Flavobacterium, Pseudomonas, Zoogloea, Xanthomonas, Chromobacterium, Enterobacteriacae, Growth factors, Isolates, Oxygen levels, Pollutants, *New Brunswick, *Systematics.

Subsurface water samples were collected from the Saint John River in October, February and August, one mile above and one mile below the effluent outflows of a food processing plant and a dairy. Aerobic heterotrophic bacteria were isolated, enumerated and identified where possible. The isolates were also examined for enzyme activity. The temperature and pH of the river water were determined at the time of sampling and the 24 hour mean flow rate between sampling locations was recorded. The fluctuation in the genera of bacteria observed indicated that seasonal factors influenced the bacterial population. Many of the isolates required growth factors; the most common one was cyanocobalamin. The ability to store poly-beta-hydroxybutyrate was prevalent in the summer isolates, rare in the winter bacteria. The predominant bacteria in the winter samples were Alcaligenes, Flavobacterium, fluorescent Pseudomonas and Xanthomonas species. Zoogloea species were dominant in August. Chromobacterium, Enterobacteriaceae and non-fluorescent Pseudomonas, as well as Zoogloea, were predominant in the October samples. (WATDOC)
W82-06559

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,
T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 24-33, Tab, Fig.

Descriptors: *Saint John River, Florenceville Site, *Bacterial study, *Heterotrophic bacteria, Numerical analysis, Isolates, Eutrophication, Taxonomy, Population shifts, Organic loading, Methodology, Water quality, Temperature variations, *New Brunswick.

Seasonal river water samples obtained at the point source of the effluent from the McCain food processing plant have been analyzed for numbers and types of heterotrophic bacteria by numerical taxonomy and for temperature and pH. Bacterial counts varied from 10,000 to 1 million (CFU/ml). Forty per cent of the September river samples required growth factor and 17-32% required unknown growth factors. This growth factor requirement was shown again to be seasonal. The February isolates were more versatile nutritionally and more of the isolates utilized a wide range of substrates. The winter organisms were able to grow well at a wide temperature range in contrast with the September isolates which did not grow at 4 C. The starch discharged by the food processing plant did not produce an increase in starch hydrolyzing bacteria. The samples obtained above and below the point source of the effluent yielded isolates of similar characteristics, whereas the effluent isolates were distinctly different indicating that the effluent bacteria were not retained as a major segment of the river bacterial population. It was concluded that the effluent bacteria were diluted by the river to numbers below detection by the methods employed in this study. (WATDOC).
W82-06560

BACTERIA UNDER THE ICE,
T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 34-42, Fig, Tab.

Descriptors: *Taxonomy, *Numerical analysis, *Bacterial populations, *Ice, *Pollutant Identification, Water quality, Reference strains, Pseudomonas fluorescens, Aeromonas, Derxia, Flavobac-

terium, Effluent clusters, Alcaligenes, Biotypes, Runoff, DNA analysis.

All February isolates which survived the culturing procedures were analyzed by numerical taxonomy. The analysis included reference strains and effluent isolates which rarely clustered with their river counterparts. The clustered strains were identified by classical methods and the identification was supported by DNA analysis. The predominant species found at both river sites were P. fluorescens biotypes B, E and F and Flavobacterium. P. stutzeri as well as other nonspeciated Pseudomonas were also observed. River clusters were identified also as Klebsiella, Aeromonas, Sphaerotilus natans and Azotobacter. The effluent clusters, which contained only strains from the effluent, included Derxia, Aeromonas, Pseudomonas, Alcaligenes and Pseudomonas sp. The data base of the numerical taxonomy made it possible to group strains to simplify the classification and to identify their locations. The bacteria isolated from the river two miles apart showed great similarities and the dilution of the effluent strains indicated that bacteria introduced into the river by the effluent did not become part of the free-floating population downstream. These findings supported the preliminary work of Chalifour and Holder-Franklin. (WATDOC)
W82-06561

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,
C. J. Cormier, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 43-77, Fig, Tab.

Descriptors: *Heterotrophic bacteria, *Meduxnekeag River, *New Brunswick, *Population shifts, *Taxonomy, *Seasonal variations, *Diurnal changes, Heterogeneity, Bacterial species, Pollutants, Genera, Isolates, Cluster analysis, Temperature variations, Aeromonas, Flavobacterium, Pseudomonas, Xanthomonas campestris, Water quality.

Seasonal and diurnal changes in the heterotrophic bacterial community isolated from the Meduxnekeag River at the Environment Canada monitor, Belleville, N.B., were observed in March, July, September and October. A detail of the numerical taxonomy is presented to show the efficacy of using this method to detect population shifts. The variety of species observed in these samples indicated a complexity of the bacterial flora not observed previously. Although temperature is a highly selective environmental parameter, it was shown in this study that a very diverse population was present in September and October in samples taken two weeks apart and at the same temperature. Aeromonas, Flavobacterium and non-fluorescent Pseudomonas were predominant in September, whereas in October owing to the diurnal variation certain species predominated according to sampling time. Beginning at noon, Pseudomonas carophylli, a non-fluorescent organism, and Xanthomonas campestris were preeminent. At early evening, P. fluorescens obtained a clear majority and only two strains of P. carophylli remained. Another shift placed the Flavobacterium in greater numbers by midnight. The March samples demonstrated very low numbers clustering with great heterogeneity in the samples. The shift to fluorescent Pseudomonas observed in other winters at other sampling sites was not seen. A variety of organisms were isolated in July with a slight shift to the more fermentative groups. Diurnal variation was not as apparent in March and July.(WATDOC)
W82-06562

DIURNAL VARIATIONS OF THE HETEROTROPHIC BACTERIA IN THE SEDIMENT AND WATER OF A SMALL WOODLAND STREAM,
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 78-89, Tab, Fig.

Descriptors: *Heterotrophic bacteria, *Dunbar River, *Bacterial enumeration, *Diurnal variations, Water quality, Sediment populations, Water populations, Mathematical analysis, Taxometric analysis, Physico-chemical parameters.

Diurnal variation in certain biological, physical and chemical parameters was observed in water samples collected from the Dunbar River, a pristine woodland stream, periodically during a 56-hour period in August. A reduction in 02, pH, C and P was accompanied by a decrease in chlorophyll and bacterial counts in water and sediment incubated at 20 C. As darkness descended, the turnover time took a noticeable upswing followed by buildup in N03 and eventual peaking of the Vmax. Dusk also brought an increase in sediment counts at 5 C. Another peak was observed in these sediment psychrophiles at dawn. Species varied somewhat- an increase in fermentative enterics was observed during the day, with the converse true of the aerobic, non-fermentative group. The modest cycling of species in ;this study was also observed in the Meduxnekeag in a previous summer study. The factor analysis demonstrated the clear differences in the sediment and water populations. Links between these populations are only speculative from the results reported here. (WATDOC)
W82-06563

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 90-98, Tab.

Descriptors: *Meduxnekeag River, *Dunbar River, *Nutrient transformations, *Population shifts, Aquatic ecosystems, Sediment samples, Heterotrophs, River isolates, Pseudomonas fluorescens, Delafieldi, Acidovorans, Cytophaga fermentus, Taxonomy, *New Brunswick.

The Meduxnekeag and Dunbar rivers, in addition to having differing water uses and physico-chemical parameters, show large differences in sediment structure. The Meduxnekeag has a dark grey silty mud, whereas the Dunbar has a coarse gravel. The sediment counts are always at least one order of magnitude greater than the river counts. Counts in the Meduxnekeag sediment are about ten times higher than counts in the Dunbar sediment. Correlations between total heterotrophic counts in sediment and water are insignificant. There is thus little overall interchange in numbers. The Meduxnekeag sediment is highly typical of these river systems in lacking fluorescent pseudomonads. The Dunbar sediment harbours twice as many obligate aerobes as does the overlying water. The sediment populations in both rivers accumulate more PBH than the water populations, have a lower frequency of anaerobiosis and fermentation, are more mesophilic and less proteolytic and lipolytic. Four factors express the variability in the Meduxnekeag populations. Only three factors emerge for the Dunbar populations. These three factors all have a strong oxidative bias. Oxidative bacteria are believed to reside in the Dunbar sediment and possibley seed the overlying water. These populations are more affected by changes in water parameters than the water populations. Fermentative bacteria are believed to reside in the Meduxnekeag sediment and seed the overlying water. The Meduxnekeag sediment populations are largely unaffected by changes in the physico-chemical nature of the water. Viable counts in the Meduxnekeag water are influenced primarily by rainfall and organic C. Sediment populations are only effected by NH4. Ammonia is the key variable influencing both sediment and water counts in the Dunbar. These differences between sediment populations are attributable largely to the difference in sediment structure. (WATDOC)
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,
Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131, 1981. 347 p 107 Fig, 31 Tab, 143 Ref.

Descriptors: *Canada, *Eutrophication, *Nutrient reduction, *Loading estimates, Phosphorus, Chlorophyll, Oxygen depletion, Diagnosis, *Oliogotrophic lakes, Secchi transparency, Hydraulic load, Lake Classification, Pollutant identification.

The OECD International Programme on Eutrophication has been designed for cross sectional comparison of lakes to provide management with simple tools to evaluate nutrient reduction, particularly phosphorus, necessary to alleviate excessive eutrophication. The scope of the Canadian programme was to test the applicability of the overall OECD results on a set of data not included in the original elaboration with three main objectives in mind; clarification of the extent to which lakes of an unspecified nature exhibit statistical properties similar to the OECD lakes, clarification and identification of the limits of transferability, identification of conditions which need further evaluation. The Canadian lakes data base represents a collection of information from personal communication with various workers involved in major limnological projects as well as that contained in the literature. It has been subdivided into seven major geographical regions which are treated separately. In a diagnostic sense, the majority of Canadian lakes tested show statistical behaviour similar to that of the OECD lakes, particularly in regard to the relationships between annual mean chlorophyll and annual mean phosphorus, annual mean phosphorus and flushing corrected inflow phosphorus concentration, and annual mean chlorophyll and flushing corrected inflow phosphorus concentration. However, application of the results for predictive purposes requires care. A number of limiting conditions were identified under which applicability and transferability of OECD results are either questionable or should be done with utmost care. These include situations where: euphotic zone depth/mean depth is substantially greater than one; hydraulic load is high (q sub s is greater than 50 m/y). flushing rate is more than twice/year and/or lakes with irregular flushing regimes either seasonally or over consecutive years; high mineral turbidity or a high degree of humic staining exists; N/P ratios are greater than 5 and/or P exeeeds 100 mg/cu m; phosphorus is relatively inert (e.g. as apatite) or internal loading is substantial and dynamic equilibrium has not been attained as in the case of increasing or decreasing nutrient loads. (WATDOC)
W82-06566

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 7C.
W82-06567

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,
Canada Centre for Inland Waters, Burlington (Ontario).
A Mudroch.
Scientific Series No 122, 1981. 44 p, 14 Fig, 35 Tab, 106 Ref.

Descriptors: *Great lakes, *Coastal lake marshes, St. Lukes, Dover, Cootes Paradise, Balmoral, Big Creek, Walpole Island, *Chemical composition, *Trace elements, Nutrients, Water quality, Marsh

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water, Sediments, Geochemistry, Wetlands, Macrophytes, Metals, Nitrogen, Phosphorus, *Pollutant identification, *Lake Erie, *Lake Ontario, *Lake St. Clair.

Six marshes adjacent to the Great Lakes were investigated to evaluate their beneficial and/or detrimental effects on the water quality of the lakes. The nutrient (N and P) and trace element (Pb, Cu, Cr, Ni, Cd, As and Hg) concentration changes in marsh water, the geochemistry of sediments, and the nutrient and trace element uptake by marsh plants and their biomass production were investigated. The marsh water retained pH values of between 7.8 and 8.4, and the sediments were submerged mineral soils with pH ranging between 6.9 and 7.2 with more than half of the particles in the silt size (2-63 micro m) fraction. Concentrations of nutrients and trace elements in march water and sediment were compared with those found in lakes Ontario and Erie. Large differences were observed between the concentrations of various forms of nitrogen present in marsh, lake and stream water. Most of the nitrogen present in the marsh water was in the form of organic nitrogen. Dissolved oxygen concentration in the marsh water during summer months remained relatively high (4-8 mg per L). The nutrient input to the marshes affected the aboveground biomass production and the species composition in the marshes. Submerged macrophytes accumulated higher concentrations of Pb, Cr, Ni, Cd, Co and Cu than the emergent macrophytes. All of the marshes studied showed a high capacity to retain nutrients and metals. The degree of this retention depended on the hydrological regime and species composition in the marsh. It was calulated that a complete discharge of the marshes into the adjacent lakes would contribute only negligible quantities of N Nd P in relation to the loadings from other sources. (WATDOC)
W82-06570

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
For primary bibliographic entry see Field 5B.
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 71, 1981. 9 p, 1 Fig, 7 Tab, 8 Ref.

Descriptors: *Polychlorinated biphenyls, *Pollutant identification, *Sediments, Dixon procedure, Webb-McCall procedure, Comparable levels, Extraction, Organics, Contamination, Quality control, Homogeneity, Interlabratory studies, Data collections.

This study describes an interlaboratory comparison of the analysis of polychlorinated biphenyls (PCBs) (a 1:1 mixture of Aroclors 1254 and 1260) at concentrations of about 1 ppm in 10 to 20 spiked wet sediment. The average coefficient of variation (16.2%) of the present study is very similar to previously reported results in other interlaboratory PCB studies at comparable levels. The variation of results among laboratories in this study appears to be due to the variation in quantitation methods more than to the variation in extraction and cleanup procedures. The laboratories that used the Webb-McCall quantitation procedure gave better accuracy and precision than those that used other quantitation procedures. (WATDOC)
W82-06575

WATER QUALITY OF THE UPPER NIAGARA RIVER, 1975 AND 1979,
Canada Centre for Inland Water, Burlington (Ontario).
K. W. Kuntz, and C. H. Chan.
Scientific Series No 129, 1982. 22 p, 13 Tab, 7 Fig, 12 Ref.

Descriptors: *Upper Niagara River, Tonawanda Channel, Chippawa Channel, Quality control, *Chemical analysis, Statistical data, Nutrients, Trace metals, Microbiology, Organic contaminants, Ion concentration, *Pollutant identification.

In 1975 and 1979, surface water samples were collected on the Upper Niagara River for a wide variety of analyses including nutrients, major ions, trace metals, toxic organic contaminants and microbiological parameters. Results indicated higher concentrations of nutrients, trace metals and bacteriological parameters in the Tonawanda Channel than in the Chippawa Channel of the Upper Niagara River. Major ion Concentrations have remained relatively constant between 1975 and 1979. Nutrients data remain unchanged except for an increase in nitrate nitrogen and a decrease in particulate organic carbon. Total iron concentrations and total and fecal coliform counts in the Tonawanda Channel frequently exceeded water quality objectives of the 1972 Canada/United States Great Lakes Water Quality Agreement. (WATDOC)
W82-06576

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Ouellet.
Environment Canada, Inland Waters Directorate, Quebec, Canada, Scientific Series No 123, 1981. 37 p 99 Ref, 4 Tab, 14 Fid.

Descriptors: *Lac Laflamme, *Quebec, *Paleolimnology, *Geochemistry, *Geochronology, Fallout, *Air Pollution, *Stratigraphic distribution, Precipitation, Acid rain, Acidification, *Sediments, Ecosystems, Plankton, Water quality, *Pollutant identification.

The present paleolimnological study, which deals essentially with the geochemical and biological characteristics of the most recent sediments of Lac Laflamme, is part of an integrated research program recently initiated by Environment Canada. This research program is aimed at achieving a better understanding of the effects produced on the environment by the fallout of pollutants transported over long distances in the atmosphere. This report deals with the geochronological and geochemical aspects, and with the composition and abundance of the fossil groups of algae and crustaceans over time. The stratigraphic increase in 137Cs, Na, Cu S, Ca, Hg, Ni, Pb and Zn, beginning primarily in the levels corresponding to the 1940s, reflects the quantities of these elements released into the atmosphere by various anthropogenic activities. However, for the same period of time, there is a slight decline in Al and Ca levels in the sediments of Lac Laflamme, which may be attributable to the greater mobility of these elements as a result of the effects of precipitation acidification. To date, the high capacity of the loose sediments in the lake for ion exchange has prevented acifification of the lake's waters, which still maintain a pH level of approximately 6.1. This neutralization capacity has thus enabled the paleocommunities of algae and cladocerans to remain in equilibrium over the past several hundred years. (WATDOC)
W82-06577

EVALUATION OF A SYSTEM TO AUTOMATICALLY SAMPLE ZOOPLANKTON FROM THE DISCHARGE OF DAMS,
Cooperative Fishery Research Unit, Amherst, Massachusetts
R. A. Rosen.
Water Resources Bulletin, Vol 18, No 1, p 147-152, February, 1982. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Zooplankton, *Measuring instruments, Dams, Flow discharge, Crustaceans, *Sampling, Water quality, *Automatic sampling, *Massachusetts, Connecticut River, Holyoke Pool.

Although zooplankton are excellent biological indicators of water quality, they can be difficult or time consuming to routinely monitor. Swanson proposed a means to automatically sample plankton from the intake water at dams in 1965. However, although this system can reduce or nearly eliminate the labor involved in an extensive sampling program and can sample at any time for any duration, it has received only modest use. Two samplers were operated continuously for more than two years to monitor the crustacean zooplankton influx into and discharge from the Holyoke Pool of the Connecticut River in Massachusetts. The sampling efficiency of these two samplers was evaluated and compared to that of a conventional towed-net sampler. The automatic samplers efficiently sampled most species and size classes of crustacean zooplankton in a similar, but not consistently identical, manner to the towed-net plankton sampler. The automatic sampler captured the smallest sized zooplankton more efficiently than the largest representatives. Mesh selection and sampler avoidance exerted different influences on the automatic samplers and on the towed-nets. The study results indicate that direct use of the results from automatic samplers, individually or in comparison with results from other automatic samplers, provides a valid and accurate assessment of plankton density and species composition in waters passing through a dam. (Carroll-FRC)
W82-06628

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 2K.
W82-06630

RIGHT PLACE, TIME AND TECHNIQUE: RIGHT SAMPLE,
ISCO, Inc., Lincoln, NE.
D. M. Grant.
Water-Engineering and Management, Vol 129, No 7, p 28-32, June, 1982. 3 Fig, 3 Tab.

Descriptors: *Sample preservation, *Water sampling, *Sampling, *Pollutant identification, Wastewater analysis, Sample preparation.

The importance of proper sampling techniques, representative samples, and sample preservation in water and wastewater analysis are emphasized. Reliable analytical data are vital in water pollution control in the key areas of policy planning, program planning, and enforcement. The best method for obtaining the most representative sample depends on flow data, character and variability of the source, and the objective of the program. Two types of samples are discrete (grab) and composite. Discrete samples are preferred when the source does not flow continuously, when extreme conditions must be detected, when the source is relatively constant, and when time variations are needed. Composite samples may be simple, flow-proportional, or sequential. They give a good indication of average characteristics. Types of sample gathering systems are described: mechanical, forced flow,

and suction lift. Frequency of sampling depends on the variability of the source. Volume depends on the type of analysis. A table lists the required volume, type of container, preservative measures, and recommended holding time for about 50 wastewater constituents. Generally, the minimum volume for discrete samples is 100 ml; for individual aliquots of composite samples, 25 ml, with a total composite volume of 4 liters or more. Refrigeration is the most common sample preservation method to prevent chemical and microbiological activity during storage. Obviously, immediate analysis is preferable to storing samples. (Cassar-FRC)
W82-06642

ALGAE AND CRUSTACEANS AS INDICATORS OF BIOACTIVITY OF INDUSTRIAL WASTES,
Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh, K. M. Duke, and R. B. Foster.
Water Research, Vol 16, No 6, p 879-883, June, 1982. 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Industrial wastes, *Bioindicators, Toxicity, Water pollution sources, Bioassay, Pulp wastes, Pulp and paper industry, Algal growth, Crustaceans, Laboratory studies.

The effects of 10 industrial waste samples on Selenastrum capricornutum, a freshwater alga, and Skeletonema costatum, a marine alga, were studied in laboratory bioassays. Effects on growth of these algae were compared to toxicity to crustaceans that are considered to be pollutant-sensitive species: Daphnia magna (freshwater) and Mysidopsis bahia (marine). The effluents tested included wastes from three paper mills, two textile mills, two fiber plants, an oil refinery, a chemical manufacturing plant and a tannery. None was strongly inhibitory to algal growth, but all stimulated growth at low concentrations. No waste type appeared to be either more or less bioactive than any other. From the results it was concluded that algal growth bioassays with complex industrial wastes need not be conducted for longer than 4 days. Daphnia magna and Mysidopsis bahia were less sensitive to the wastes than were the algae. Algal data were valuable in calculating the 7-day, 10-year, low flow rates required for safe disposal of the effluents. Algal data indicated need for greater dilution and thus afforded a greater margin of safety than did animal data. (Baker-FRC)
W82-06654

DESIGN AND OPERATION OF A COLORIMETRIC DETECTOR CONTROLLER,
Natal Univ., Durban (South Africa).
R. H. Turnbull.
Water Research, Vol 16, No 6, p 801-808, June, 1982. 10 Fig, 3 Tab, 2 Ref.

Descriptors: *Design criteria, *Colorimetry, Water analysis, Water quality, Measuring instruments, *Pollutant identification.

This report covers the design and operation of a suitable colorimeter based on the ADMI color method. The colorimetric detector controller is suitable for industrial applications with a color detection range of 100 ADMI units. The design is based on the measurement of the response in the blue, green, and red light bands covering the 400-700 nm spectrum. The fourth detector is used for detecting ferric ions in the range of 0-5 mg/liter, by detecting the color complex ferri-ferro-cyanide. With decreasing water quality, shorter light path lengths will be required, with corresponding reduction in sensitivity. (Baker-FRC)
W82-06656

A WATER QUALITY INDEX FOR LAKE BEACHES,
Eco-Recherche Ltd., Pointe-Claire (Quebec).
For primary bibliographic entry see Field 5G.
W82-06660

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,
Geological Survey, Tallahassee, FL.. Water Resources Div.
B. G. Waller, and W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-194960, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-3, 1982. 70 p, 23 Ref, 20 Tab, 27 Ref.

Descriptors: *Water quality, *Canals, *Wastewater, *Environmental effects, Land use, Urban runoff, Pollutants, Water sampling, Sediments, Nutrients, Pesticides, Water analysis, Data collections, *Florida, Broward County.

An intensive water-quality monitoring program was started in 1969 to determine the effects of man-induced contaminants on the water quality in the primary canal system of eastern Broward County, Florida. This report covers the first 6 years of the program and provides a data base that can be used to compare future changes in water-quality conditions. Most data indicate that beyond the small seasonal fluctuation in constituent level, the greatest adverse effect on the quality of water is caused by discharge of sewage and treated sewage effluent to the canals. The areas affected by sewage have greater concentrations of macronutrients, trace metals, and pesticides than unaffected areas. Major-ion concentrations were affected only by season and local lithology. Over the 6-year study a gradual decrease in macronutrient concentration and an increase in dissolved oxygen have occurred. This improvement in water quality is attributed to a decrease of sewage discharge into canals and better treatment of sewage effluents. (USGS)
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06688

ORGANOCHLORINE RESIDUES IN FISH FROM LAKE MJOSA IN NORWAY,
Institutt for Energiteknikk, Kjeller (Norway).
E. M. Brevik.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 5, p 679-680, May, 1981. 1 Tab, 6 Ref.

Descriptors: *Pesticide residues, *Fish, *Chlorinated hydrocarbons, Pollutant identification, Air pollution, Polychlorinated biphenyls, DDT, Organic compounds, Hexachlorobenzene, *Lakes, Aquatic life, Norway, Mjosa Lake.

Levels of total DDT, polychlorinated biphenyls (PCB), and HCB in livers of lagesild (Coregonus albula) from Lake Mjosa, Norway, did not change significantly, according to annual sampling from 1974 to 1979. Total DDT ranged from an average of 0.7 to 3.1 ppm (fat weight basis); PCBs, 1.5 to 6.7 ppm; and HCB, 0.11 to 0.29 ppm. These freshwater fish samples contained only one fifth the levels of organochlorine compounds normally found in ocean fish from relatively un-contaminated fjords and open ocean. (Cassar-FRC)
W82-06697

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,
Missouri Univ., Kansas City. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06702

ON THE DETECTION OF MUTAGENIC/CARCINOGENIC ACTIVITIES IN WATER WITH THE SALMONELLA/MICROSOME TEST (AMES TEST)(ZUM NACHWEIS MUTAGENER/KANZEROGENER AKTIVITATEN IN WASSERN MIT DEM SALMONELLA/MIKROSOMEN-TEST (AMES-TEST)),
Mainz Univ. (Germany, F.R.). Hygiene Inst.
E. H. Pfeiffer.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 39-41, January, 1982. 16 Ref. English summary.

Descriptors: *Drinking water, *Ames test, *Carcinogens, *Pollutant identificaion, *Mutagens, Testing procedures, Water quality, Pollutants, Salmonella, Toxins, Bioindicators.

The Ames test is described and its use for detecting mutagenic and carcinogenic substances in various waters is evaluated. The use of this test to identify carcinogens rests upon the assumption that a correlation exists between the mutagenic and carcinogenic effects of a given substance. However, this relationship appears to be restricted to compounds that react directly with DNA or that can be transformed metabolically into electrophilic alkylating substances. It is estimated that 75-90% of known carcinogens in the Ames test are also mutagens, and false negatives and positives each account for about 10% of substances tested. The Ames test is usually applied to newly developed chemicals, and its use in complex substances such as drinking water and dust opens up a new field. The test can indicate the presence of harmful substances in drinking water and point to multiplication and summation effects in the presence of certain other substances. Substances with antagonistic or inhibitory effects may affect the result, and the possibility also exists that a substance may not be present in a concentration high enough to give a positive result. Thus the usefulness of the Ames test may be affected by the chemical preparation of the water sample for the test. Nevertheless the Ames test can be used to screen water for possible mutagenic and/or carcinogenic substances, after which further mutagenicity tests (e.g. cell culture) should be conducted. Animal experiments are necessary to test for carcinogenicity. (Gish-FRC)
W82-06715

MULTIPLE POTENTIOMETRIC SYSTEM FOR CONTINUOUS DETERMINATION OF CHLORIDE, FLUORIDE, NITRATE, AND AMMONIA IN NATURAL WATERS,
Warsaw Univ. (Poland). Dept. of Chemistry.
M. Trojanowicz, and R. Lewandowski.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 308, No 1, p 7-10, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Monitoring, *Water analysis, *Potentiometers, *Pollutant identification, *Chlorides, *Fluorides, *Nitrates, *Ammonia.

Chloride, fluoride, nitrate, and ammonia were simultaneously determined in natural waters using a flow-through system suitable for routine monitoring. Sensors used were solid state chloride and fluoride electrodes, a nitrate PVC membrane electrode with solid silver contact, and a gas-sensing ammonia ORION 95-10 electrode. The incoming samples were segmented by air and mixed with appropriate buffering solutions before entering the measuring cells. The method was tested over the concentration ranges (in ppm) of 30-150 for C1, 0.08-0.4 for F, 5-20 for nitrate, and 0.05-0.5 for ammonia. The system was used to monitor tap water for 6 months and to monitor river quality at Warsaw for 2 months. Accuracy was about + or - 10%. Time for analysis was 15 min. (Cassar-FRC)
W82-06718

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,
State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
For primary bibliographic entry see Field 5C.
W82-06721

COMPARISON OF FILTRATION TECHNIQUES FOR SIZE DISTRIBUTION IN FRESHWATERS,

LIBRARY U. OF I., URBANA-CHAMPAIGN

Edinburgh Univ. (Scotland). Grant Inst. of Geology.
D. P. H. Laxen, and I. M. Chandler.
Analytical Chemistry, Vol 54, No 8, p 1350-1355, July, 1982. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Filtration, *Natural waters, Water analysis, Particle size, Filters, Screens, Separation techniques, Particulate matter, Suspended solids, Trace metals, Water pollution control, Sample preparation.

A more systematic insight into the filtration of freshwaters was sought with emphasis on the following points: to compare depth filters (Sartorius) and screen filters (Nuclepore) of different nominal pore size with a view toward determining their respective suitability for size distribution studies; to compare filtration using stirred and unstirred samples, the former being designed to prevent or minimize accumulation of material on the filter; to compare size distributions based on immediate filtration in the field with filtration performed several hours later in the laboratory; and to compare filtration through glass fiber filters with membrane filters. It was concluded that screen filters (Nuclepore) provided more accurate size fractionation, so long as the filter was not allowed to clog. No benefit was derived from stirring the sample during filtration. Field filtration was necessary to achieve the most reliable size fractionation. The criteria used to evaluate filtration properties are iron and manganese filtrate concentrations and scanning electron microscope examination of the filtered particulates. (Baker-FRC)
W82-06731

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,
Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
G. Langeland.
Applied and Environmental Microbiology, Vol 43, No 5, p 1111-1115, May, 1982. 3 Tab, 21 Ref.

Descriptors: Wastewater facilities, *Bacteria, Salmonella, Human diseases, Oslo, *Norway, Sludge, Occupational hazard, *Pollutant identification.

The presence of Salmonella spp. in the working environment and sewage sludge at three sewage works in Oslo was investigated. Ten series of samples were taken at intervals of 2 months from April 1979 to November 1980. The last three series also included samples from plant influent and effluent. Salmonella bacteria were isolated from surfaces and areas with hand contact in the treatment plant, from floor surfaces in the changing rooms, and in one case from floor surfaces in an eating room. The sewage sludge contained from 140 to 140,000 Salmonella spp per 100 g dry weight. Raw and treated sewage contained an average of 130 and 3 of these bacteria per 100 ml, respectively. There were poor correlation between the pattern of serotypes isolated from the sewage works and the patterns of those which were registered among the population of Oslo during the investigation. Neither enteropathogenic bacteria nor parasite eggs were found in fecal samples from employees at the plant. The health aspects of the situation are considered. With the exception of Salmonella paratyphia-B, the Salmonella strains found are unlikely to cause disease after oral intake at these levels. However, if contamination of a suitable foodstuff occurs, multiplication of these Salmonella strains could reach the level required for an infective dose. (Baker-FRC)
W82-06734

EVALUATION OF CELL LINES AND IMMUNOFLUORESCENCE AND PLAQUE ASSAY PROCEDURES FOR QUANTIFYING REOVIRUSES IN SEWAGE,
Utah State Univ., Logan. Dept. of Biology.
D. N. Ridinger, R. S. Spendlove, B. B. Barnett, D. B. George, and J. C. Roth.
Applied and Environmental Microbiology, Vol 43, No 4, p 740-746, April, 1982. 6 Tab, 25 Ref.

Descriptors: *Viruses, *Wastewater, Cultures, Water pollution control, Water analysis, Water quality, *Reoviruses, *Pollutant identification.

A versatile assay method is needed for the more than 100 different viruses excreted by humans into sewage. Reoviruses have been suggested for use in developing such an assay technique. The sensitivities to reoviruses of 12 continuous cell lines were compared. Three of these 12 cell lines were then compared using unserotyped reovirus precipitated from sewage by protamine sulfate. The most sensitive cell line was subsequently used in a comparative study of the plaque and the ICC assay procedures. Madin-Darby bovine kidney (MDBK), rhesus monkey kidney (LLC-MK2) and human embryonic intestinal (intestinal 407) cells were most sensitive to reovirus types 1, 2, and 3 respectively. MDBK cells were more sensitive than LLC-MK2 and Buffalo green monkey (BGM) cells to sewage-isolated, protamine-precipitated reoviruses which had not been serotyped and had no previous cell contact. Sewage-isolated, protamine-precipitated reoviruses were also used in conjunction with MDBK cells in a comparative evaluation of immunofluorescent cell count and plaque assay procedures. The immunofluorescence assay is more sensitive and more rapid than the plaque assay. Reoviruses in excess of 10000/liter of raw sewage were detected by the immunofluorescent cell count assay. Reoviruses were concluded to possess the characteristics required for water pollution test viruses. MDBK cells are sufficiently sensitive to reoviruses to permit reovirus detection in < 24 hr. (Baker-FRC)
W82-06735

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,
Kurita Water Industries Ltd., Yokohama (Japan).
S. Nishikawa, S. Sakai, I. Karube, T. Matsunaga, and S. Suzuki.
Applied and Environmental Microbiology, Vol 43, No 4, p 814-818, April, 1982. 9 Fig, 1 Tab, 7 Ref.

Descriptors: Water analysis, *Microbiological studies, Water treatment, Wastewater treatment, Water pollution control, Bacteria, *Pollutant identification.

A new electrode system using a fuel cell-type electrode, a redox dye, and a porous acetylcellulose membrane filter for trapping microorganisms is described. The electrode was constructed from a platinum anode, a silver peroxide cathode, and a membrane filter for retaining microorganisms. The principle of cell number determination was based on sensing with the electrode a redox dye reduced by the microorganisms. Sample solutions containing microorganisms were membrane filtered, and the resulting filter containing microbial cells was attached to the surface of a platinum anode. The electrode was immersed in phosphate buffer solution containing a redox dye, and the current generated was measured. The response time of the electrode system was 10 to 20 minutes, and the current generated was proportional to cell populations above 10,000 cells/ml. (Baker-FRC)
W82-06743

COMPARISON OF FOUR MEMBRANE FILTER METHODS FOR FECAL COLIFORM ENUMERATION,
Ontario Ministry of the Environment, Rexdale.
J. E. Pagel, A. A. Qureshi, D. M. Young, and L. T. Vlassoff.
Applied and Environmental Microbiology, Vol 43, No 4, p 787-793, April, 1982. 8 Tab, 17 Ref.

Descriptors: *Membrane processes, *Coliforms, Membrane filters, Filters, Membranes, Bacteria, Water analysis, Water quality, Water pollution control, *Pollutant identification.

The relative performance of four membrane filter (MF) enumeration methods for fecal coliforms was evaluated by determining performance characteristics. Three pure cultures of fecal coliforms were used for the study: E. coli 104, E. coli B, and Klebsiella pneumoniae. Recovery accuracy with pure cultures ranged from 89 to 100% for m-FC, mTEC and m-FC2 methods, but was less than 60% for the MacConkey membrane broth method. These figures dropped by about 40 to 55% when the cultures were subjected to temperature stress. Nearly 800 colonies were verified to determine specificity. False positive colonies occurred most frequently (18%) with the m-FC2 method, whereas false negative colonies were most common on MacConkey membrane broth (26%). In counting range experiments using a variety of samples, the highest upper counting limit was 130 colonies per filter with the mTEC procedure. Recovery comparisons were based on more than 130 samples, including raw surface waters, raw sewage, and chlorinated and unchlorinated sewage effluents. Recoveries were generally higher with the m-FC2 and mTEC methods. However, on m-FC2, growth of nontarget background organiams was also higher in most cases. Highest recoveries from chlorinated sewage effluents were obtained by th mTEC method, and the addition of a similar resuscitation period to the m-FC procedure improved fecal coliform recovery from such samples. The best overall performance for fecal coliform enumeration was obtained with the mTEC method, giving high recovery and low levels of background colonies, good specificity and accuracy, and high upper counting limit. This procedure also offers the advantage of enumerating. E. coli within 24 hr. (Baker-FRC)
W82-06744

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,
University of West Florida, Pensacola. Dept. of Biology.
M. T. MacDonell, and M. A. Hood.
Applied and Environmental Microbiology, Vol 42, No 3, p 566-571, March, 1982. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Estuaries, *Bacteria, Coastal waters, Gulf Coast, *Estuarine environment, Marine waters, Nutrients, Vibrio, Aeromonas, Pseudomonas, Alcaligenes, Microorganisms, Ultramicrobacteria, *Alabama, Perdido Bay.

The warm waters of a Gulf Coast estuary were examined for the presence of ultramicrobacteria, and an attempt was made to isolate these organisms and to phenotypically characterize them. Water samples were taken from about 10 cm below the surface at four sites in Perdido Bay, Alabama, during April-June 1981. These sites were less impacted by human actvities and represented a wide range of salinities. Visual confirmation of bacteria in the water was made through fluorescent microscopy. Of the 27 isolates, 89% were initially incapable of growth in any of several full strength nutrient rich broths. Further more, no isolate was capable of a single positive reaction in full strength biochemical media. Several dilutions of various media were tried until the optimum concentration of an eight-fold dilution was obtained, which permitted the organism to grow while providing enough indicator for classical color reactions to be noted. The organisms were being inhibited by the rich nutrient concentrations. Adaptation to a nutrient-rich medium was accomplished and was accompanied by a pronounced increase in size. The majority of the isolates were oxidase positive and catabase positive. All were gram negative, and with a single exception, all were motile. With three exceptions every isolate was string test positive. Some phenotypic environmental Aeromonas spp. are also able to produce positive string test reactions. Because of the high incidence of positive reactions produced by the Perdido Bay isolates, the string test may be a meaningful characteristic, although the significance of the test is unclear at this time. The abundance and the nutritional requirements of the ultramicrobacteria found imply that they represent a class of microorganisms which have successfully adjusted to poor nutrient conditions. (Baker-FRC)
W82-06747

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,
Wisconsin Univ., Eau Claire. Dept. of Biology.
C. A. Meadows, and B. H. Snudden.
Applied and Environmental Microbiology, Vol 43, No 4, p 953-954, April, 1982. 2 Tab, 5 Ref.

Descriptors: *Enterobacter, *Water analysis, Human diseases, Diseases, Bacteria, Yersinia enterocolitica, Rivers, Bacterial analysis, Water pollution effects, Public health, Seasonal variations, *Wisconsin, Chippawa River basin.

A total of 303 water samples were collected between March 1978 and May 1979 in the lower Chippewa River drainage basin, including the river, tributary streams, and storm sewer outflows. Samples were tested for Yersinia enterocolitica, which causes serious gastrointestinal illness in humans. Selective media included MacConkey-Tween 80 agar and Y-M agar. A new method of isolation was developed. Fecal coliform tests demonstrated a considerable variation in water quality at sample sites. Fecal coliforms counts increased in spring and summer and decreased in winter. Woodland streams had lower coliform counts than polluted urban storm sewer effluent or streams which were subject to agricultural runoff. Of the 303 water samples, 78 had greater than 200 fecal coliforms per 100 ml sample. Y. enterocolitica occurred in 25 samples, 22 of which were from rural areas and 3 from urban areas. No common source was evident. Twenty-four of the isolates were obtained with the anaerobic-aerobic technique, and one was obtained with the Y-M agar plate technique. A seasonal variation in Y. enterocolitica occurrence was noted, with only one isolation being recorded outside of the period from November through April. The ability to withstand low temperature was evident. In general Y. enterocolitica was isolated more frequently in the winter season. (Baker-FRC)
W82-06751

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W82-06752

USE OF HOECHST DYES 33258 AND 33342 FOR ENUMERATION OF ATTACHED AND PLANKTONIC BACTERIA,
Naval Research Lab., Washington, DC. Environmental Sciences Div.
J. H. Paul.
Applied and Environmental Microbiology, Vol 43, No 4, p 939-944, April, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: Water analysis, *Bacteria, Measuring instruments, Dyes, Water quality, Acridine orange, Bacterial analysis, *Pollutant identification.

The bisbenzimide dyes Hoechst 33258 and 33342 are examined as stains for epifluorescent enumeration attached and free-living bacteria, attached to smooth surfaces and in natural waters. The method has distinct advantages over acridine orange (AO) staining when enumerating bacteria on surfaces which bind this dye. The presence of greater numbers of autofluorescent particles in natural water samples when viewed in the blue excitation wavelengths required for AO may also cause an overestimation of bacteria during AO counting. The use of DNA-specific stains with UV excitation such as the Hoechst dyes 33258 and 33342 and DAPI can ameliorate this problem. Cultures of estuarine bacteria gave identical counts when stained with Hoechst 33258 or AO, whereas natural populations of aquatic bacteria gave 92 to 98.5% of the acridine orange counts. (Baker-FRC)
W82-06754

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,
Cawthron Inst., Nelson (New Zealand).
L. W. Belser, and E. L. Mays.
Applied and Environmental Microbiology, Vol 43, No 4, p 945-948, April, 1982. 2 Tab, 14 Ref.

Descriptors: *Nitrification, *Bacteria, *Sediments, Soils, Oxidation, Ammonium, Microbiological studies, Biomass, *Pollutant identification.

A simple method for measuring maximum activities of indigenous ammonium oxidizer populations was applied to a number of soils and intertidal sediments. A shaken soil or sediment slurry was incubated, and the second step of nitrification, nitrite oxidation, was inhibited by chlorate. Under these conditions the rate of ammonium oxidation was equal to the rate of nitrite accumulation. Nitrapyrin, a specific inhibitor of nitrification, was added during the incubation to demonstrate that nitrite was produced from autotrophic ammonium oxidation. The most probable number (MPN) counts ranged between 150 to 3000 cells/gram in sediments and between 4400 to 19000 cells/g in soils. These counts were only 0.1 to 5.0% of the estimated populations that would be needed to produce the observed activity. Similar efficiency calculations were made for data already in the literature, and these calculations gave much higher percentages. Thus it was concluded that for the soils and sediments studied, the MPN counting technique greatly underestimated the populations present and that the efficiency calculation could be used as a counting efficiency index. (Baker-FRC)
W82-06755

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,
Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, C. P. Gerba, and V. C. Rao.
Applied and Environmental Microbiology, Vol 43, No 3, p 731-733, March, 1982. 3 Tab, 10 Ref.

Descriptors: *Viruses, *Public health, Toxicity, Wastewater, Settling basins, Raw wastewater, Water analysis, Water quality, Water pollution control, Pollutant identification, Filtration, Centrifugation.

The widespread use of tissue cultures for virus assays requires that cytotoxicity of virus concentrates be minimized. The reduction of cytotoxicity in virus concentrates from environmental samples was accomplished through high-speed centrifugation and by filtration of the samples through positively charged depth filters. The level of toxicity reduction depended on the type of sample used. Water samples studied included those from raw and treated wastewater and from pond sediments. Of the various treatments for reducing cytotoxicity of sewage concentrates, filtration through positively charged depth filters (Zeta-plus, type 50D) was the most effective and reduced the toxicity in 24 of 25 samples tested. The type 5S filter, which has a larger pore size, was much less effective. The negatively charged type 50D and Millipore types GS and HA were also less effective than the 50S filter. Centrifugation at 34,000 x g for 1 hr was the second most effective treatment, with four of six samples showing improvement. Centrifugation at 8,500 x g for 1 hr improved 37% of the samples tested. Treatment with XAD-2 resin columns improved 6 of 11 samples. Freon treatment was the least effective technique, with only 1 of 15 samples improving. Concerning the degree of toxicity reduction, filtration through 50S filters gave 1.2 to 4.4-fold reductions in cytotoxicity. Generally, as the degree of cytotoxicity in the original sample increasd, the reduction in toxicity by 50S filtration decreased. Centrifugation of concentrates from sewage pond sediments at 8500 x g for 1 hr followed by assay of the supernatant revealed a 3.4 fold decrease in toxicity. Whether a treatment which reduces cytotoxicity also reduces the number of infectious virus particles in the sample was also investigated. The 50S filters removed more than 99.9% of the Escherichia coli from suspensions containing 10,000 cells per ml of 0.05 M glycine with or without tryptose phosphate broth or beef extract, but no appreciable loss of virus particles was seen. (Baker-FRC)
W82-06757

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,
Calgary Univ., Alberta. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06770

APPLICABILITY OF LIGHT ABSORBANCE AS A MEASURE OF OGANIC CARBON IN HUMIC LAKE WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, T. De Boer, H. A. Kramer, and J. Voerman.
Water Research, Vol 16, No 6, p 1047-1050, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Chemical oxygen demand, *Organic carbon, *Pollutant identification, Ultraviolet radiation, Tjeukemeer, *The Netherlands, *Humic acids, Lakes, Turbidity, Water analysis, Oxygen demand.

Ultraviolet absorbance at 250 nm (E250) was a suitable estimator of dissolved organic carbon in humic, eutrophic water from Tjeukemeer, the Netherlands. The correlation of E250 with COD of filtered water samples did not change from year to year during 1970-1980 (with the exception of 1970-72, during a period of sediment resuspension) and was independent of sampling stations. Absorbance at 365 nm showed linear correlations but was more variable. The variability of the water quality (from oligohaline, transparent, and eutrophic in summer to fresh, highly colored, and eutrophic in winter) did not interfere with the method. Although turbidity measurements at 436, 530, and 620 nm and COD data from unfiltered water samples were linearly correlation coefficients and slopes of the correlation varied irregularly. (Cassar-FRC)
W82-06773

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,
Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
S. A. Nichols.
Water Resources Bulletin, Vol 18, No 3, p 521-523, June, 1982. 3 Tab, 9 Ref.

Descriptors: *Biomass, *Sampling, Aquatic plants, Stratification, Stratified flow, Lakes, Lilly Lakes, *Wisconsin, *Pollutant identification.

The value of a stratified random system for improving the efficiency of biomass sampling is discussed along with factors which might be used to stratify samples. A case study is demonstrated at Lilly Lake, Wisconsin, where a statified random sampling reduced sampling effort by about 37%. During the summer of 1976 a sampling plan was devised to estimate macrophyte biomass of Lilly Lake. At that time the lake area was 36.6 hectares, with a maximum depth of 2.4 meters. The lake was dredged after 1976. The bottom was primarily muck, with sand and gravel predominating in the shallow water along the southeast shore. Ten strata were constructed. A preliminary survey was undertaken on August 10, 1976, to determine the biomass variability of the strata. Biomass variations within and between strata were analyzed using a one-way analysis of variance test. A significant difference in mean biomass was demonstrated. According to the data collected, about 308 samples would be needed to adequately sample the lake in a completely random fashion. In the case of Lilly Lake approximately three person days of effort would be saved for each time it was necessary to adequately sample the biomass of the lake using the stratified random sampling system proposed. This procedure can be used to design similar sampling strategies where information about species composition or growth curves for important macrophyte species is desired. (Baker-FRC)
W82-06779

SEPARATION OF AQUEOUS ORGANIC MIXTURES BY PERVAPORATION AND ANALYSIS BY MASS SPECTROMETRY OR A COU-

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PLED GAS CHROMATOGRAPH-MASS SPECTROMETER,
Centre de Recherches Rhone-Poulenc Industries, Aubervilliers (France).
H. Eustache, and G. Histi.
Journal of Membrane Science, Vol 8, No 2, p 105-114, March, 1981. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Pervaporation, *Organic compounds, *Membrane processes, *Pollutant identification, Water analysis, Wastewater analysis, Industrial wastewater, Mass spectrometry, *Chlorinated hydrocarbons, *Aromatic compounds, Volatile compounds, Separation techniques, Gas chromatography.

A quick method for analysis of volatile organic compounds in dilute aqueous solution includes separation by pervaporation coupled with mass spectrometry or gas chromatography/mass spectrometry. The pervaporation process uses a membrane with the liquid mix on one side and a vacuum on the other. As the compounds pass through the membrane they are directly analyzed by mass spectrometry. Of the 4 membranes studied, TS-605, a cross-linked polydimethylsiloxane on a polyester support, has the highest enrichment factors for most compounds tested (benzene, styrene, chloroform, 1,2-dichloroethane, ethanol, acetone, acetic acid, n-butyl acetate, ethyl ether, pyridine, acetaldehyde, and vinyl chloride). Covitep, a low density polyethylene, is better than TS-605 for toluene, n-hexane, and cyclohexane. Polyethylene terephthalate and cross-linked polyvinyl alcohol membranes show little evidence of enrichment. Four examples are described: assay of trace levels of styrene in water, assay of trace levels of vinyl chloride in water, identification of oxygenated impurities of 1,2-dichloroethane, and analysis of industrial wastewater before treatment. (Cassar-FRC)
W82-06791

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, NV.
A. F. Maciorowski, L. W. Little, L. F. Raynor, R. C. Sims, and J. L. Sims.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 830-848, June, 1982. 325 Ref.

Descriptors: *Literature reviews, *Bioassays, *Reviews, Water quality, Fish, Aquatic life, Monitoring, Bioindicators, *Pollutant identification, Pollutants, Water pollution control.

Recent research conducted in the area of bioassays to describe, evaluate, and predict potential hazards related to water pollution is cited in this literature review. Biodegradation testing methodology of chemicals as well as their fate in aquatic environments formed the subject of a symposium. The development and applicability of US EPA water quality criteria were reviewed. Biological monitoring took on a variety of meanings. A tiered approach to effluent monitoring using both chemical and biological test protocols was prepared. Sentinel organisms to indicate contamination of natural waters by pollutant accumulation and uptake constituted another approach to biological monitoring. The radionuclides americium-241 and plutonium-237 were found to turn over differentially in the mussel Mytilus galloprovincalis, and were discribed as the sum of three exponential functions. Work was also carried on in the areas of design, interpretation, and strategy of toxicity test systems; in the use of bacteria to detect pollutant effects; in assays with algae and other plants; on the use of invetebrates to detect toxic substances; on fish and amphibians as bioassay test organisms; on comparative testing in microcosms; and in health effects assays. (Baker-FRC)
W82-06810

MODIFICATION OF THE HYDROGEN PEROXIDE METHOD OF DETERMINATION OF TOTAL PHOSPHORUS IN NATURAL WATERS,
Centro de Edafologia y Biologia Aplicada del Cuarto, Seville (Spain).
F. Cabrera, E. Diaz, C. G. Toca, and P. De Arambarri.
Water Research, Vol 16, No 6, p 1061-1064, June, 1982. 3 Tab, 8 Ref.

Descriptors: *Water analysis, *Phosphorus, Natural waters, Marshes, Rivers, Chemical analysis, Digestion, *Pollutant identification.

Possible explanations for apparently conflicting analyses in the determination of 'total dissolved and suspended phosphate' and 'filterable orthophosphate' are discussed. A modification to the hydrogen peroxide-sulfuric acid digestion method used for determining total dissolved and suspended phosphorus in natural waters is presented in order to avoid loss of phosphorus by adsorption on hydrous iron and aluminum oxides formed during neutralization prior to filtration. By adding an extra volume of sulfuric acid after neutralization so that such oxides are dissolved, thus permitting the adsorbed phosphorus to pass into solution, more reliability for the method is obtained. Water samples were studied from the Guadiamar river and Guadalquivir marshes. The results indeed confirm that the presence of iron and/or aluminum materials in these natural waters may cause a loss of phosphorus when it is determined by the hydrogen peroxide-sulfuric acid method. The loss of phosphorus is dependent upon the final acidity of the digestion liquor filtrate and is overcome if the acidity is high enough to dissolve the hydrous oxide precipitated by neutralization with sodium hydroxide. The evidence suggests that a period of 30 minutes after the addition of 0.5 ml of 5N sulfuric acid was sufficient time to dissolve the iron and aluminum precipitation before filtering. (BakerFRC)
W82-06828

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,
Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
For primary bibliographic entry see Field 5C.
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
P. S. Tabor, and R. A. Neihof.
Applied and Environmental Microbiology, Vol 43, No 6, p 1249-1255, June, 1982. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Microorganisms, *Microscopy, *Respiration, Bacteria, *Pollutant identification, Fluorescence, Estuarine environment, Microbiological studies.

Individual respiring microorganisms and the total microbial population were determined by a combination of two methods: detection of electron transport system activity and epifluorescence microscopy. 2-(p-iodophenyl-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) was reduced by the active cellular electron transport system to INT-formazan, visible as opaque intracellular deposits upon staining the microorganisms with acridin orange. Microorganisms were transferred from a filter to a gelatin film on a cover glass, then coated with additional gelatin to produce a transparent matrix. This method detected 2- to 10-fold more respiring microorganisms in a Chesapeake Bay water sample (56-61%) than were previously reported for marine or fresh water samples. Significant losses in microorganism counts were experienced when samples were prepared with immersion oil or Nuclepore filters. (Cassar-FRC)
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
P. A. Montagna.
Applied and Environmental Microbiology, Vol 43, No 6, p 1366-1372, June, 1982. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Bacteria, *Sampling, *Sediments, Microscopy, Mud, Sand, *Pollutant identification, Marine sediments, North Inlet, South Carolina, Statistical analysis.

The spatial and temporal distribution of marine bacteria in two types of sediments, muddy and sandy, were examined at a subtidal site at North Inlet, South Carolina. The experiment was designed to study the statistical aspects of sampling bacteria in the sediment, where bacteria are numerous and adhere to particles. The cell count, determined by acridine orange epifluorescence microscopy, fit a log-normal distribution. Bacterial numbers were 100 billion per g dry weight of mud and 1 billion per g dry weight of sand. Vvariations due to subsampling procedures were always statistically significant. The common practice of counting 20 fields from 1 filter preparation, adequate for bacterial counts in the water column, was not suitable for determining the bacterial population variance in marine sediments. It was recommended that replication of the subsampling level be performed. Data indicated that bacteria were more homogeneously distributed in sand than in mud. (Cassar-FRC)
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,
Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
E. M. Smith, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 43, No 6 p 1440-1450, June, 1982. 4 Fig, 8 Tab, 47 Ref.

Descriptors: *Wastewater analysis, *Microbiological studies, Rotaviruses, Water analysis, *Pollutant identification, Houston, *Texas, Pathogens, Diseases.

A method for concentrating rotaviruses from tap water, treated sewage, and raw sewage was developed using the simian rotavirus SA11. The method was based on adsorption to and elution from Filterite fiberglass epoxy filters. Optimal conditions for adsorption of the virus were 0.5 nM AlC13 at pH 3.5 and for elution, 0.05 M glycine-NaOH supplemented with 10% tryptose phosphate broth at pH 10. The SA11 was counted by plaque assay; the human rotavirus, by immunofluorescence. Rotavirus was detected in raw and treated dewage from two Houston, Texas, treatment plants. Several criteria confirmed that the rotavirus was a human strain: immunofluorescence, neutralization with convalescent sera from humans infected by a rotavirus, neutralization or immunofluorescence with preimmune or preillness sera, sensitivity to pH 11 and other inactivating agents, byoyant density of 1.36 g per cu m (comparable to that reported for complete, infectious rotavirus particles), and a double-shelled particle diameter of 67.1 nm. The electron micrograph of cell lysates inoculated with sewage isolate showed particles similar to rotavirus in morphology. (Cassar-FRC)
W82-06885

FLUOROMETRIC DETERMINATION OF DNA IN AQUATIC MICROORGANISMS BY USE OF HOECHST 33258,
Naval Research Lab., Washington, DC.
J. H. Paul, and B. Myers.
Applied and Environmental Microbiology, Vol 43, No 6, p 1393-1399, June, 1982. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Bacteria, *Deoxyribonucleic acid, *Fluorometry, *Pollutant identification, Microorganisms, Water analysis, Microbiological studies, Dyes, Hoechst 33258, *DNA.

Microbial DNA was detected at 0.05-10 microgram levels in bacterial cultures and natural water samples by a method based on the use of Hoechst 33258 dye, which increases in fluorescence in the presence of DNA. The simple process involved extraction of DNA and determination of DNA by fluorometry. A study of extraction methods showed that sonication after suspension in SSC (NaCl, trisodium citrate solution at pH 7.0) and sonication of cells on membrane filters released

100-104% of the DNA. Treatment of extracts with DNase I showed that 95-100% of the observed fluorescence was from DNA. DNA was correlated with bacterial cell numbers as determined by the acridine orange direct count. DNA in environmental samples ranged from 165 ng per ml in eutrophic Potamac River water to 27 ng per ml for coastal Atlantic Ocean water. (Cassar-FRC)
W82-06889

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
D. A. Brashear, and R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 6, p 1413-1418, June, 1982. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Viruses, *Sludge analysis, Wastewater analysis, Pollutant identification, *Elution, Centrifugation, Flocculation, Freon, waste treatment.

Five methods for recovering viruses from raw domestic wastewater sludge were compared. All methods included elution, concentration, and disinfection steps. Methods were: (1) freon elution, (2) water elution, (3) beef extract elution, (4) ASTM-1, aluminum chloride and beef extract, designed for primary and digested sludges, and (5) ASTM-2, beef extract and sonication, designed for anaerobically digested sludge. The most effective method was freon elution, followed by centrifugation and disinfection with ether. Concentration by centrifugation was more effective than by flocculation. Average relative virus recoveries, based on freon elution centrifugation results as 1.0, were: Method 2 with centrifugation, 0.72; Method 3 with centrifugation, 0.59; Method 4 unconcentrated, 0.57; and Method 5, 0.27. Efficiency of recovery was greatest in BGM cells, followed by RD and MA-104 cells. (Cassar-FRC)
W82-06890

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,
Veterans Administration Medical Center, Pittsburgh, PA.
For primary bibliographic entry see Field 5B.
W82-06891

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,
Michigan University, Ann Arbor. Great Lakes Research Division.
W. Y. B. Chang, and R. Rossmann.
Hydrobiologia, Vol 88, No 3 p 245-249, May, 1982. 3 Tab, 13 Ref.

Descriptors: *Chlorophyll, *Phytoplankton, *Sample preparation, Algae, *Sonification, *Grinding, Diatoms, Cyanophyta, Water analysis, *Lake Michigan.

The chlorophyll recovery efficiencies of control, ground, and sonificated samples of phytoplankton were compared with samples collected at a depth of 5.5 m in the intake forebay of the Donald C. Cook Nuclear Plant on Lake Michigan. The six treatments used were: (1) control, (2) 45 sec sonification in an ice bath, (3) 45 sec sonification in an ice bath with vigorous shaking, (4) 3 min sonification in an ice bath, (5) 3 min grinding, and (6) 3 min grinding in an ice bath. Chlorophyll b levels were very low; no significant differences in recovery efficiencies were discerned. However, significant increases in concentrations of chlorophylls a and c were found between control and ground samples but not between controls and sonificated samples. Increasing sonification time or using an ice bath during grinding did not improve pigment recovery efficiency. Results of the 1976 samples tested (containing centric diatoms and filamentous blue-green alga) showed that ground samples exhibited 22-40% more chlorophyll a and 62-87% more chlorophyll c than sonificated samples. However, the 1977 samples, except for one showed no significant differences. Grinding recovered more chlorophyll c than sonification when total phytoplankton numbers were high. Grinding is the preferred method for sample preparation, but in some cases it may not improve recovery compared to no grinding. These situations include phytoplankton populations under severe nutrient limitation or subjected to extensive herbivore predation or to disease. (Cassar-FRC)
W82-06902

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 5C.
W82-06907

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,
Freshwater Fisheries Lab.
For primary bibliographic entry see Field 5C.
W82-06909

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,
Environmental Protection Agency, Cincinnati, OH.
R. H. Bordner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 024-1037, June, 1982. 156 Ref.

Descriptors: *Literature reviews, *Microbiological studies, *Water analysis, *Wastewater analysis, *Bacterial analysis, Microorganisms, Quality control, *Pollutant identification, *Reviews, Pathogens, Coliforms, Salmonella, Sampling, Monitoring, Bioassay, Toxicity, Mutagens, Bacteria, Vibrio, Water quality, Aeromonas, Klebsiella.

A review of recent literature on microbiological methods in water and wastewater analysis includes the 15th edition of 'Standard Methods for the Examination of Water and Wastewater.' About 75 papers are noted which concern new isolation and enumeration procedures. Many of these are comparisons of different procedures such as membrane filter, most probable number and its variations, plating, and direct count using coliforms and other fecal bacteria. Selective procedures are given for microorganisms such as Legionella pneumophila, Yersinia, Campylobacter, Vibrio, Aeromonas, Klebsiella, Salmonella, and Listeria. There is great interest in commercially available diagnostic kits, multitest systems, and automated computerized methods for bacterial identification, as evidenced by about 25 publications on testing and comparison of these systems. Sampling considerations include special problems of collecting specimens from boats, under ice cover, in stratified waters, from aquifers, in streams, wastewaters, boiler water, industrial effluents, sediments, at bathing beaches, and in deep waters. New approaches to rapid methods for bacterial enumeration are discussed. Examples are radiometric, serological, electrochemical, enzyme, chromatographic, and chemiluminescent methods. Bacteria are used in bioassays for toxic or mutagenic substances, for example, Nitrobacter for assessing wastewater toxicity, effects of dyes on bacterial action, and improvements and development of the Ames Salmonella test. Quality control schemes are described, using control cultures and statistical methods. Several possible sources of error are mentioned, such as stacking plates, and nonuniform cooling rates. Health hazards to laboratory workers include infections from pathogens used in the Ames test and typhoid fever from the very infectious Salmonella typhi, sometimes used in testing disinfectants. (Cassar-FRC)
W82-06919

ORGANICS,
Washington Univ., Seattle. School of Public Health and Community Medicine, Department of Environmental Health.
F. B. DeWalle, C. Lo, J. Sung, D. Kalman, and E. S. K. Chian.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, 555-576, June, 1982. 8 Tab, 242 Ref.

Descriptors: *Literature reviews, *Organic compounds, *Water anaylsis, *Wastewater analysis, *Fate of pollutants, *Pollutant identification, *Reviews, Organic matter, Biological oxygen demand, Organic carbon, Hydrocarbons, Pesticides, Insecticides, Herbicides, Sediments, Quantitative analysis, Detergents, Surfactants, Chlorinated hydrocarbons, Sludge, Polychlorinated biphenyls, Aquatic animals, Runoff, Drinking water, Groundwater, Surface water, Industrial wastewater, Degradation, Aromatic compounds.

Recent publications concerning analysis of organics in water are reviewed. An overview of nonspecific methods (total organic carbon, COD, and BOD) is followed by group methods and compound specific methods. The group methods include techniques for determination of total amounts of acids, aldehydes and hydrocarbons. Compound specific methods quantitate individual compounds. The references are grouped into 8 tables with the following headings: methods of detection and identification of detergents and related compounds; methods of identification and quantification of aliphatic and aromatic hydrocarbons; presence, degradation, and attenuation of aliphatic and aromatic hydrocarbons; methods for identification and quantification of pesticides, chlorinated hydrocarbons, and related compounds; presence, degradation, and attenuation of pesticides, chlorinated hydrocarbons, and related compounds; methods for identification and quantification of naturally occurring organics; methods for identification of organics present in surface and groundwater, drinking water, wastewater, and other media; and degradation and attenuation of organics in surface and groundwater and wastewater. These tables list the sample type (for example, sediment, wastewater, soil runoff), the compound(s) being determined, methods, and significant results. (Cassar-FRC)
W82-06922

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,
Alaska Univ., Fairbanks, Inst. of Marine Science.
W. S. Reeburgh, and R. E. Erickson.
Limnology and Oceanography, Vol 27, No 3, p 556-559, May, 1982. 3 Fig, 7 Ref.

Descriptors: *Pollutant identification, *Sampling, *Sediments, *Chemical analysis, Chemical composition, Bays, Sulfides, Measuring instruments, Interstitial waters.

An approach is presented to obtaining rapid, continuous profiles of chemical components of sediments which involves in situ equilibration of a thin band of polyacrylamide gel cast in a Lucite support or dipstick. The support-gel combination is inserted into sediments or cores and equilibrates rapidly with adjacent interstitial waters. The gels are transparent and relatively inert chemically for short exposures. They have high water content, are nonionic and are durable enough to resist tearing in sandy sediments. The gels can be dosed with specific color-forming reagents which react with components in the sediments and provide a visual semiquantitative indication of depth distributions. They can also be used as equilibration samplers and sectioned for extraction and analysis after retrieval. Results of sediment analysis using these dipstick samplers are presented for sulfide containing sediments in Skan Bay. This bay is a silled basin on the northwest side of Unalaska Island (Aleutian Islands) with anoxic sediments. Dipstick samplers, when dosed with appropriate reagents, give rapid, continuous, semiquantitative measurements of sulfide in anoxic marine sediments. (Baker-FRC)
W82-06931

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CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),
Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, Y. Yokoyama, and S. Suzuki.
Japanese Journal of Limnology, Vol 43, No 1, p 5-10, January, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: Rivers, *Organic compounds, Aromatic hydrocarbons, Aliphatic hydrocarbons, *Sediments, Ara River, Tama River, *Japan, Organochlorine compounds, Phthalate esters, Chemical analysis, Water analysis, Water pollution, Industrial wastes.

An approach for characterizing organic pollutants in sediments of an urban river is presented. The organic matter content of sediments in the downstream areas of the Tama and the Ara Rivers was 2-5 times as great as that of sediment upstream. The sedimentary organic matter was extracted successively with water, n-hexane, ethyl acetate, methanol, and 1 N NaOH. The amounts of organic water extracted with n-hexane or ethyl acetate from the downstream sediment in the Tama River were remarkably higher than those from stream sediment. In the downstream areas of the Ara River the amounts of n-hexane, water and 1 N NaOH extracts were higher than those in the upstream ones. The n-hexane extract obtained from the sediment downstream in the Tama River was further separated into three fractions by silica gel and silica gel/alumina column chromatography. These sub-fractions were characterized by IR, NMR, GC, TLC, and elemental analyses. The analyses indicated that the organic compounds present in larger amounts downstream were aliphatic and aromatic hydrocarbons, organochloine compounds and phthalate ester. (Baker-FRC)
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,
Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
L. W. Lion, R. W. Harvey, and J. O. Leckie.
Marine Chemistry, Vol 11, No 3, p 235-244, 1982. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Estuarine environment, *Trace metals, Copper, Cadmium, Lead, Estuaries, *Salt marshes, Microorganisms, Microenvironment, San Francisco Bay, Bays, Particulate matter, *Organic carbon.

The relative importance of metal complexation with dissolved surface-active organic ligands, metal adsorption to particle surfaces, and bacterial uptake of metals were evaluated as processes which control the partitioning of cadmium, copper and lead in the surface microlayer of an estuarine salt marsh. The importance of each mechanism was evaluated by comparing observed trace metal enrichment in the dissolved and particulate forms with the enrichment of dissolved organic carbon (DOC), particles and bacteria. Salt marsh field samples were obtained at the confluence of a salt marsh drainage channel with the South San Francisco Bay estuary. Little or no partioning of DOC was noted in either tidal cycle, while particle numbers and bacteria were found to be enriched at the surface microlayer in several instances. The lack of DOC partitioning suggests that little or no partitioning of dissolved Cd, Cu or Pb would be expected. Study revealed that particulate Cd, Cu, and Pb were partitioned during events in which particle enrichment was observed, and with the exception of dissolved Pb in the first sample of each tidal cycle, minimal partitioning of dissolved metals was noted in both tidal studies. The observed levels of partitioning of dissolved, particulate and total Cd, Cu and Pb and the correlation between the partitioning of particulate metals and particle numbers strongly suggest that microlayer enrichment of trace metals is controlled by the behavior of particles, for example, bacteria, organic detrital materials and inorganic components such as clay minerals. The observed distributions of Cd, Cu and Pb between the dissolved and particulate phase were consistent with their calculated chemical speciation in computer-simulated surface microlayer and bulk seawater. (Baker-FRC)
W82-06975

INORGANICS,
Pope Scientific Inc., Menomonee Falls, WI.
D. S. Polcyn.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 520-540, June, 1982. 15 Tab, 379 Ref.

Descriptors: *Literature reviews, *Inorganic compounds, *Water analysis, *Spectroscopy, *Reviews, *Pollutant identification, Computers, Quality control, Sample preservation, Trace metals, Chemical analysis, Chelation, Speciation, Metals, Heavy metals, Chromatography, Hydrogen ion concentration, Electrodes, Conductance, Atomic absorption spectroscopy, Emission spectroscopy, X-ray spectroscopy, Flow injection analysis, Voltammetry, Reagents, Potentiometers, Ion-selective electrodes.

A review of the recent literature on analysis of inorganics in water includes new books and reviews, the use of computers and microprocessors in analysis, data analysis and quality control, interactions of samples with containers, preparation of high purity reagents, corrections for air buoyancy in weighing granular or powdered materials, sample concentration, detection and distribution of trace metals, complexation, speciation, and interlaboratory studies. A table lists various constituents found in water (metals, chlorine, silicon, and other selected elements) and references concerning studies of their speciation. The remainder of the literature references on inorganic analysis is organized into 14 tables: chromatographic methods (gas, ion, and liquid); pH (analysis and methods); selective ion electrodes (reviews, theory, and application); voltammetry (reviews, theory, and applications); voltammetry and stripping analysis (anodic and potentiometric); conductance; atomic absorption spectroscopy (reviews, theory, and application); atomic absorption spectroscopy and hydride formation; flame emission spectroscopy; inductively coupled plasma emission spectroscopy; X-ray spectroscopy (emission and fluorescence); miscellaneous instrumental methods; flow injection analysis; and analysis for specific constituents. The constituents are arranged alphabetically by name and include elements, cyanide, and thiocyanate. (Cassar-FRC)
W82-06999

5B. Sources Of Pollution

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
L. N. Mielke, and J. R. C. Leavitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243452, Price codes: A02 in paper copy, A01 in microfiche. Report, June 1981. 17 p, 7 Tab, 9 Ref. OWRT A-062-NEB(1). 14-34-0001-0129.

Descriptors: *Herbicides, *Agricultural runoff, *Irrigation, *Surface runoff, *Pesticide toxicity, Pesticide drift, Sediment transport, Sediments, Sprinkling, Sprinkler irrigation, Spray irrigation, Water pollution, Water pollution sources, Irrigation practices, Irrigation effects, Environmental effects, Pollutants, Pollutant load, Water pollution effects.

Herbicide runoff losses for atrazine and alachlor were studied under three types of center pivot irrigation with conventional and minimum tillage: conventional high-pressure impact sprinkling; low-pressure impact sprinkling; and low-pressure spraying. Tillage practices that emphasize the use of the disk and minimum tillage enhance the potential for herbicide runoff. Nonetheless, herbicide losses can be minimized under topographic and soil conditions conducive to runoff by selecting the proper irrigation system. Herbicide water solubility affects the runoff pattern: water-soluble herbicides are susceptible to initial runoff events, with more of loss associated with water solubility. However, the amount of herbicide carried on the sediment is minimal, even with a relatively insoluble herbicide (e.g., atrazine). Accumulative herbicide runoff loss after three consecutive events did not exceed 0.1% of the amount applied, even under conditions favoring runoff. Furthermore, the amount of herbicide in runoff material, coupled to the degree of dilution that normally occurs between the site of runoff and herbicide-sensitive crops, is sufficient to make phytotoxic events due to herbicide runoff rare. (Zielinski-MAXIMA)
W82-05921

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,
Georgia Univ., Athens. Inst. of Ecology.
E. R. Blood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243569, Price codes: A10 in paper copy, A01 in microfiche. Report ERC 06-81, September, 1981. 194 p, 30 Fig, 26 Tab, 96 Ref. OWRT B-138-GA(1).

Descriptors: *Surface runoff, *Stream upflow, *Water analysis, *Hydrologic models, *Swamps, Surface water, Streams, Streamflow, Stream profiles, Stream discharge, Bogs, Marshes, Water quality, *Environmental effects, Hydrology, Model studies, Chemical analysis, *Okefenokee Swamp, Georgia, Florida.

Surface water runoff to the swamp from upland streams is not uniformly distributed. Low topographic relief, highly leached sandy soils, and land use practices contribute to low flow, low sediment yields and low nutrient characteristics of the upland surface water. Investigation of the swamp system level biogeochemistry and hydrology, and several factors influencing them (geomorphology, environmental variables, anthropogenic perturbations) provided some insight of swamp ecosystem homeostasis. Upland surface water low salinity and low sediment yields are a function of the predominance of silvicultural practices on the uplands. Low agricultural use and little urbanization minimize anthropogenic inputs of sediments and nutrients to the streams. The model developed provides new insights into swamp hydrology and some weaknesses of using a static model to reflect a hydrologically dynamic ecosystem. System level biogeochemistry was assessed through the biogeochemistry of the major hydrologic components. The swamp surface water is similar to other blackwater systems, having low pH and ionic strength, high organic carbon which influences water quality and chemistry, and a predominance of organic or reduced nutrient forms. Seasonal dynamics, precipitation, upland stream channelization, and cation/anion distributions are discussed. (Zielinski-MAXIMA)
W82-05933

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,
Kansas Water Resources Research Inst., Manhattan.
E. E. Angino, and D. A. Kopsick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243593, Price codes: A06 in paper cpy, A01 in microfiche. Report and Supplement to Contribution No 211, June, 1981. 110 p, 24 Fig, 16 Tab, 9 Plates, 62 Ref, 4 Append. OWRT A-087-KAN(2). 14-34-0001-8018.

Descriptors: Fly Ash, Bottom Ash, *Leachates, Water Quality, *Coal mining, *Mine wastes, *Gob, Groundwater pollution, *Geochemistry, Inorganic wastes, *Missouri.

During the coal, large amounts of inorganic material (gob) are removed with thee coal. After cleaning of the coal, this waste is deposited adjacent to the mined area. One of these gob piles, located in Barton County, Missouri, is evaluated as to chemi-

cal composition of the waste, leaching characteristics of the waste and mineralogy of secondary minerals deposited at the pile. This waste material is enriched in Pb, Zn, Cd and Cu, relative to the abundances of these elements in average shales. Leachate from this material shows elevated concentrations of Zn and Cd. After twenty-five years of weathering, this gob is still producing leachate with high concentrations of Cd, Mn, Cu, Zn and Fe. Various hydrous states of ferrous sulfate, ranging from szomolnokite, FeS04H2O, to melanterite, FeS04.7H2O were identified from minerals collected at the pile. Analysis of the monohydrate form showed enrichment in Fe, Mg, Zn, Cd, Cu and Mn, relative to the whole gob sample and leachate sample. Two types of coal combustion wastes, fly ash and bottom ash, from five coal producing provinces of the United States are discussed in relation to Ca, Mg, Na, K, Mn, Fe, Cu, Zn and Pb concentrations in the whole sample and in the leachate generated from these ashes. Fly ash from northeast Missouri coal yields a leachate enriched in Pb, Zn, Cu, Fe, Mn and Cd, relative to other leachates, which is indicative of mineralization from nearby lead-zinc deposits. Leachates from two Wyoming fly ashes and bottom ashes exhibit low trace metal concentrations and high Ca, Mg, Na and K concentrations. Intermediate between these two samples are the coompositions of leachates generated from the ashes of eastern Kentucky and southern Illinois coal. An evaluation of geology, hydrogeology, soil chemistry and groundwater chemistry at an ash disposal site of a coal-fired power plant showed elevated concentrations of Ca, Mg and Na plus K in the leachate of the coal ash relative to native groundwater. Only trace amounts of Mn, Fe, Cu, Zn are present in the ash leachate and no degradation of the local groundwater quality is predicted for this site. (See also W80-04604)
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
J. W. Talbot.
Ocean Science and Engineering, Vol 6, No 3, p 301-333, 1981. 13 Fig, 1 Tab, 23 Ref.

Descriptors: Estuaries, Water currents, *Thames estuary, *England, Mathematical models, *Model studies, *Wastewater disposal, Sludge, Sludge disposal, Ocean dumping, *Path of pollutants, Water circulation.

The problem of the dispersal of the products of sewage sludge dumping in the Thames Estuary was examined using a mathematical model in conjunction with conventional field measurements. The conventional methods employed included moored recording current meters, sea-bed drifters and a radioactive-tracer release. Some 5 million tons of digested sludge are dumped each year in the Barrow Deep channel of the outer estuary. The Thames Estuary is an area of moderate tidal velocities, in some parts 2 knots being exceeded on spring tides. It is also an area of shallow water with a complicated bottom topography, including a system of sandbanks, many of which dray out at low water and which alternate with channels whose maximum depth is about 20 meters. It was also necessary to consider the effects of the residual component, as the estuary lies between a southerly flow down the English east coast and a northeasterly flow through the Dover Strait. Dispersal is thus likely to be complex. Current meter records indicated that water takes between 2 and 2.5 hours to move from the position of a patch at 1450 hr to the position of the center of a patch found on the sea bed. The labeled sludge began to fall in the water column as high water approached, but the main deposition on the bed occurred close under the East Barrow sandbank between 2 and 2.5 hours after high water. Two major conclusions of the study were that the movement was in general to the south. However, there was some strong evidence for a northerly drift close to the Essex coast, and drifters released in the Wallet probably moved initially to the northeast before joining the general southerly drift further offshore. No evidence was found to indicate a general near-bed transport into the Thames. (Baker-FRC)
W82-05946

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-05964

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 13, No 4, p 135-138, April, 1982. 2 Fig, 2 Tab, 13 Ref.

Descriptors: Estuaries, *Radioactive wastes, *Ravenglass Estuary, *Cesium-137, Sediments, Pollutant identification, Nuclear energy, Fuel, *Path of pollutants, *England.

Ravenglass Estuary is located about 10 km south of the Sellafield nuclear fuel reprocessing facility. A survey is reported of the important gamma emitting fission products found in the surface sediments of the estuary in May of 1978. The influence of the silt sized content of the surface sediments on the geographical distribution of fission products is discussed. The results are compared with recent annual mean results published by the Ministry of Agriculture, Fisheries and Fodd (MAFF) for their monitoring of the Newbiggin site. Sediment samples were collected by carefully removing the uppermost 0.5 cm over a 1 square meter area at each location. A detailed survey of gamma emitting fission products in the surface sediments of the estuary shows that considerable variations occur, and that for cesium-137 and to a lesser extent for other radionuclides, the proportion of silt present is an important control of their distributions. The annual mean surface sediment activities reported by MAFF for a single site sampled at monthly intervals are significantly lower than those found at the majority of sites in the overall estuary. (Baker-FRC)
W82-05984

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
T. C. Lederman, and G-Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 380-387, March, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Algae, *Bioaccumulation, *Hexachlorobiphenyl, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, Accumulation, Adsorption, Phytoplankton, Insecticides, Biomass, Desorption, Fate of pollutants, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

Bioconcentration factors for 2,4,5,2', 4', 5'-hexachlorobiphenyl (HCB)were in the range off 100,000 to 1 million for Great Lakes algae Fragilaria crotonensis, Ankistrodesmus falcatus, and Microcystis sp. Bioconcentration factors were higher in A. falcatus than in the other 2 species, twice as high in dead cells as compared to live cells, lower in greater biomas es per unit volume of culture, and an order of magnitude lower for frustules than live and dead cells. Surface absorption was not an important fator in HCB bioaccumulation. F. Crotonensis cells with a mucilagenous layer had bioconcentration factors twice as high as cells with the layer removed. The concentration of HCB within the range used (up to 630 ng per liter) did not change the order of magnitude of the bioconcentration factor. Desorption rates of HCB were much lower than adsorption rates, with A. falcatus showing the greatest desorption and Microcystis the least. (Cassar-FRC)
W82-05991

VARIABILITY OF STREAM WATER QUALITY IN SOME LAND MANAGEMENT SYSTEMS IN THE SOUTHERN KAKIOKA BASIN, JAPAN,
Tokyo Univ. (Japan). Dept. of Botany.
T. Hirose, and N. Kuramoto.
Agro-Ecosystems, Vol 7, No 1, p 47-61, 1981. 4 Fig, 7 Tab, 23 Ref.

Descriptors: *Water quality, *Land use, *Forest watersheds, *Agricultural watersheds, Kakioka Basin, *Japan, Land management, Cropland, Nitrates, Nitrites, Ammonium, Phosphates, Potassium, Sodium, Calcium, Magnesium, Fertilizers, Livestock, Principal component analysis, Nutrients, Fate of pollutants, Seasonal variation.

The effects of land use on stream water quality and the diurnal and seasonal patterns of water quality were investigated at four sites in the predominantly rural Kakioka Basin, Japan. Concentrations of eight inorganic ions were determined (nitrate, nitrite, ammonium, phosphate, potassium, sodium, calcium, and magnesium). Site 2 and 4 were forest-covered. Sites 9 and 11 were cropland (paddy fields and upland fields) and livestock raising regions, but Site 11 was more heavily populated and had more livestock and fertilizer use than Site 9. Concentrations of all ions except phosphate increased with increasing land cultivation and human settlement. Principal component analysis determined that monthly veriations in ion concentrations were highly significant for all ions. Diurnal variations were significant for ammonium, Ca, and MG at Site 4; Mg at Site 9; and nitrite, ammonium, phosphate, K and Na at Site 11. At Sites 2 and 4 diurnal variations in stream water quality were small compared to monthly variations and to diurnal variations in streams under human influence. At Sites 9 and 11 diurnal variations were quite large, sometimes exceeding monthly variations. (Cassar-FRC)
W82-06020

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06033

THE ROLE OF SUSPENDED SOLIDS IN THE ESTUARINE GEOCHEMISTRY OF MERCURY,
Lancaster Univ. (England). Dept. of Environmental Sciences.
J. E. Rae, and S. R. Aston.
Water Research, Vol 16, No 5, p 649-654, May, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Suspended solids, *Mercury, *Estuary, Fate of pollutants, Adsorption, Wyre Estuary, England, Tides, Industrial wastes, Organic carbon, Mixing, Particle size, Sediments.

The mercury budget in surface waters of the Wyre Estuary, England, was studied at eight stations during a tidal cycle. This system is contaminated with industrial wastes, including chlor-alkali plant effluents. Mercury was strongly associated with suspended solids; the soluble fraction was never more than a few percent of total Hg present. At high chlorinity periods Hg concentrations in suspended solids decreased significantly and were correlated with increases in particle grain size (decreased surface area and decreased organic carbon content). Hg concentrations in suspended solids were linearly correlated with percentage organic carbon. Laboratory leaching experiments proved that Hg was not easily desorbed from particulate matter but was associated with the organic carbon fraction of the sediments. (Cassar-FRC)
W82-06035

LIBRARY U. OF I., URBANA-CHAMPAIGN

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. Gibs, R. J. Schoenberger, and I. H. Suffet.
Water Research, Vol 16, No 5, p 699-705, May, 1982. 8 Fig, 4 Tab, 16 Ref.

Descriptors: *Buffer capacity, *Landfills, *Leachates, Carbonates, Model studies, Sanitary landfills, Organic acids, Acids, Degradation, Hydrogen ion concentration, Anaerobic conditions, Fate of pollutants.

A model of the buffer capacity of sanitary landfill leachate, based on the products of anaerobic decomposition, assumes that all organic acids are acetic acid. This simplification reduces the number and complexity of required chemical analyses and the calculations. The model was tested on two samples (winter and summer) of Bucks County, Pennsylvania, Landfill. The model predicted maximum buffer capacity pH within 0.35 of the actual value, but underpredicted the magnitude by 8-16%. It was accurate over a pH range of 6 to 10 for the winter sample and 3 to 10 for the summer sample. Carbonate contributed a minimum of 67% to the maximum buffer capacity. (Cassar-FRC)
W82-06038

ESTIMATION OF PRE- AND POST-DEVELOPMENT NONPOINT WATER QUALITY LOADINGS,
General Development Corporation, Miami, Florida, Environmental Planning and Programs Department.
A. N. Shahane.
Water Resources Bulletin, Vol 18, No 2, p 231-237, April, 1982. 2 Fig, 10 Tab, 16 Ref.

Descriptors: *Pollution load, *Land use, *Community development, *Nonpoint pollution sources, Water quality, Water pollution sources, Fate of pollutants, Runoff, Florida, Urban development, Nitrogen, Phosphorus, Suspended solids, Biological oxygen demand.

Three approaches were used to estimate pre- and post-development water quality loadings from two proposed Florida residential communities. Results from the second approach most closely resembled the results of the time-consuming third approach, a conventional hydrologic budget model combined with pollutant concentrations. The second approach involved summing existing annual data for recorded storms to produce pounds per acre per year loadings for suspended solids, total nitrogen, total phosphorus, and BOD5, determining the land use types for each phase of community development, and estimating pre- and post-development water quality loadings in terms of areal coverages of different land uses at various phases of development. Land use types included highways, flatwood/range, woodland, swamp, pasture, improved pasture, cultivated, residential multifamily, and commercial. (Cassar-FRC)
W82-06043

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,
Liverpool Univ. (England). Dept. of Oceanography.
D. Airey, and P. D. Jones.
Water Research, Vol 16, No 5, p 565-577, May, 1982. 5 Fig, 2 Tab, 50 Ref.

Descriptors: *Mercury, *Particulate matter, *Industrial wastes, *Path of pollutants, Fate of pollutants, Mersey Estuary, Dredging, Liverpool Bay, Pollution load, Rivers, Estuaries, Sediments.

Mercury levels were measured in water and suspended matter at 53 stations in the Mersey River system, quarterly from August 1973 to June 1974. A graph depicts the Hg load on particulate matter (micrograms per g), suspended Hg (micrograms per liter), and dissolved Hg (ng per liter). Highest mean Hg levels were found in the River Water (270 ng per liter dissolved Hg, 1.92 micrograms per liter particulate Hg, and > 80 micrograms per g Hg load) and in the Manchester Ship Canal (249 ng per liter, 1.2 micrograms per liter, and 24.3 micrograms per g, respectively). Most Hg was associated with particulates, more than 80% in a heavily polluted section where fresh water and seawater met. The load of Hg on particulates was low in August. Dissolved Hg concentrations and Hg load on particulate matter were always greater in freshwater than in tidal waters except during a flood. Low dissolved Hg levels were found in fresh water in August and in seawater in November; high levels were found in fresh water in June. Suspended Hg concentrations were higher in tidal areas than at fresh water stations. The estimated mean annual weight of Hg entering Liverpool Bay during the study period was 1.55 tons transported by water flow and 17 tons by dredging the channel and dumping spoils in the Bay. (Cassar-FRC)
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
M. E. Woolston, W. G. Breck, and G. W. VanLoon.
Water Research, Vol 16, No 5, p 687-691, May 1982. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Metals, *Bioindicators, *Algae, Fate of pollutants, Copper, Cadmium, Zinc, Manganese, Trace levels, Heavy metals, Ascophyllum nodosum, Seaweeds, Indicators, Accumulation, Bioaccumulation, Estuaries, St. Croix Estuary, Passamaquoddy Bay.

Concentrations of Cu, Cd, Mn, and Zn were determined in samples of the brown seaweed, Ascophyllum nodosum, collected in the St. Croix Estuary and Passamaquoddy Bay, between Maine and New Brunswick. There were greater statistical differences in concentrations of Mn, Cd, and Zn (but not Cu) between sites than between samples. Metal concentrations at different sites indicated trends, areas of uniformity, and local pollution sources. However, within any element there was no constancy of concentration factors (ratio of concentration of a particular element in the plant to that of the element in the water). (Cassar-FRC)
W82-06050

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,
Caulfield Inst. of Tech., Caulfield (Australia), Water Studies Centre.
B. T. Hart, S. H. R. Davies, and P. A. Thomas.
Water Research, Vol 16, No 5, p 605-612, May, 1982. 6 Fig, 2 Tab, 18 Ref.

Descriptors: Metals, *Sediment transport, *Pollution load, *Fate of pollutants, Heavy metals, Magela Creek, Australia, *Iron, *Manganese, *Zinc, *Copper, *Cadmium, Suspended solids, Conductivity, Denudation, Tropical regions, Weathering, Baseline studies.

Water quality in Magela Creek, Australia, was determined during five major floods during the 1978-79 wet season. This highly weathered undisturbed watershed contains uranium deposits recently approved for mining. Conductivity was low, 10-21 micros per cm. Suspended solids were 5-46 mg per liter, highest during the early stages of a flood event. It was calculated that in an average year 5300 tons of sediment were transported past the sampling point, representing a very low annual denudation rate. Trace metals loads were very low. Mean metals concentrations (micrograms per liter) were: Fe, 281; Mn, 7.8; Zn, 2.8; Cu, 0.41; and Cd, 0.04. Trace metals were also very low. Total amounts (in kg per sq km) transported during the wet season were: Fe, 117; Mn, 3.6; Zn, 1.3; Cu, 0.2; and Cd, 0.02. (Cassar-FRC)
W82-06054

EFFECTS OF DISSOLVED ORGANIC MATTER ON ADSORPTION OF HYDROPHOBIC ORGANIC COMPOUNDS BY RIVER- AND SEWAGE-BORNE PARTICLES,
Wisconsin Univ.-Madison. Water Chemistry Program.
J. P. Hassett, and M. A. Anderson.
Water Research, Vol 16, No 5, p 681-686, May, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Adsoprtion, *Particulate matter, *Organic compounds, *Cholesterol, Polychlorinated biphenyls, Suspended solids, *Fate of pollutants, Dissolved organic carbon, Organic carbon, Organic matter, Wastewater.

Adsorption of labeled cholesterol and 2,2',5,5'-tetrachlorobiphenyl by suspended solids from river water and treated sewage was studied in distilled water, sewage and river water and was compared to adsorption in solutions of organic matter concentrated by ultrafiltration. Sewage particulate matter was more effective in adsorption than river particulates. Dissolved organic matter reduced sorption of the two hydrophobic compounds by the particulate matter. Possible reasons for this interference are formation of complexes between the study compounds and the dissolved organic matter or competitive adsorption. Partition coefficients and standard free energies of adsorption are listed. (Cassar-FRC)
W82-06056

STORM RELATED DILUTION OF CONDUCTANCE IN THREE HYDROLOGICALLY DIFFERENT WATER BODIES,
State Univ. of New York at Syracuse, Coll. of Environmental Science and Forestry.
V. A. Ferro.
Water Resources Bulletin, Vol 18, No 2, p 311-316, April, 1982. 2 Fig, 13 Ref.

Descriptors: *Conductance, *Storm water, *Urban runoff, Fate of pollutants, Water quality, Ponds, Canals, Streams, Syracuse, New York, Butternut Creek, Runoff, Overland flow.

Electrial conductance was monitored in three water bodies on the fringe of metropolitan Syracuse, New York, in the summer of 1980 to determine the effect of precipitation on water quality. Results of measurements in a groundwater pond, Butternut Creek, and a canal showed that water quality was a function of hydrologic, precipitation, and watershed characteristics. In the groundwater pond means dry weather conductance was 1250 micromhos per cm. Precipitation and overland flow produced dilutions of 50-150 micromhos per cm in the littoral zone. A seasonal peak of 1400 micromhos per cm was attained in late August during a period of evaporative losses and low rainfall. In the creek the mean dry weather conductance was 740 micromhos per cm. Dilution, which decreased this value from 50 to 200 micromhos per cm, was governed by the orientation of the summer storm track (from the west) to the creek orientation (northerly). Extreme fluctuations in conductance (50-750 micromhos per cm) were measured in the Butternut Feeder Canal (mean base flow conductance 1175 micromhos per cm). These were a result of differences in land use. The steep urbanized areas contributed high amounts of dissolved solids to the canal. (Cassar-FRC)
W82-06067

SEDIMENT-WATER INTERACTIONS OF CU, ZN, AND PB DISCHARGED FROM A DOMESTIC WASTE WATER SOURCE INTO A BAY OF LOUGH NEAGH, NORTHERN IRELAND,
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey.
Environmental Pollution, Series B, Vol 3, No 3, p 199-214, 1982. 3 Fig, 8 Tab, 61 Ref.

Descriptors: *Sediment-water interfaces, Metals, *Zinc, *Copper, *Lead, Phosphorus, Sediments, Wastewater disposal, Path of pollutants, Trace metals, Municipal wastewater, *Ireland(Northern).

This study describes the influence of a mainly domestic wastewater discharge on the trace metal

regimes of Kinnego, Closet and Derryadd Bays, Southwest Lough Neagh, Northern Ireland, by means of their sediments. Lough Neagh is a shallow eutrophic lake which has developed to its present state through progressive cultural eutrophication. Two sewage disposal works discharge into the area, dumping sewage from primarily domestic sources. Surficial and pre-contamination concentrations of nickel, copper, zinc, lead, and phosphorus were measured at fourteen sites in the bays. Copper, zinc, lead, and phosphorus contamination was found in Kinnego Bay. The contamination increased towards the trace metal source, and copper was incorporated more rapidly into the sediment than the other metals. There was no contamination in the other bays. The current chemical models of trace metal behavior in aquatic systems were examined, and the selective incorporation of copper into the sediment was in agreement with model predictions. It was concluded that chemisorption to the sediment is the main sediment-water interaction of copper, zinc, and lead discharged in the waste water. (Baker-FRC)
W82-06080

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-06081

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2E.
W82-06093

WATER QUALITY AND HYDROLOGY IN A COASTAL REGION OF THE NETHERLANDS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
E. Van Rees Vellinga, C. G. Toussaint, and K. E. Wit.
Journal of Hydrology, Vol 50, No 1/3, p 105-127, March, 1981. 15 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality, *Saline water intrusion, *Surface water, *Netherlands, Agriculture, Fertilizers, Groundwater, Wastewater, Water pollution sources, *Rhine River, Hydrology, Aquifers, Geology, Geohydrology, Seepage, Chlorides, Polders, Path of pollutants, Cooling water, Phosphates, Nitrogen compounds, Infiltration, Transmissivity.

This paper summarizes the results of a 1976 multidisciplinary investigation on the geology, hydrology, and quality of surface water and groundwater in a 2000 sq km area of central-west Netherlands, where water quality has been deteriorating. The main problems are the pollution of the Rhine River water, used for water level control and flushing of polders; saline intrusion caused by harbor enlargement and deepening and by lowered polder levels; increases in demand for water in domestic and insturial uses, glasshouse horticulture, and agriculture; and increases in quantities of wastewater. The main source of salt contamination is seepage of saline groundwater; human activities are of minor importance. The geology of the region is described in detail. There are generally two aquifers, separated in some places by dividing layers and in other places forming a single thick aquifer. Transmissivities and flow intensity computations indicate 3 kinds of areas: seepage zones, infiltration zones, and zones with little seepage or infiltration. In the seepage zones surfce water quality reflects that of the groundwater. Infiltration zones require addition of Rhine River water during dry periods. The zones with little water movement are sensitive to digging, subsoiling, and channel improvement, all of which can change seepage rates. Groundwater in the area is generally hard and high in Fe, Mn, N, and phosphates. Chloride present in the water bearing strata of the region is about 430,000 metric tons; total net quantity welling up in the region, 150 metric tons per year. A table lists the sources and amounts of chloride inputs into surface waters. The gravest concern is the quality of the Rhine River water, which directly affects surface water quality in this area. Although seepage from natural sources cannot be changed to a great degree, water management has reduced the contributions of pollutants from cooling waters (via a direct pipeline to the North Sea), domestic wastewater, gas wells, and road defrosting. Fertilizer use is not expected to decrease. (Cassar-FRC)
W82-06103

THE OILSPILL RISK ANALYSIS MODEL OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
R. A. Smith, J. R. Slack, T. Wyant, and K. J. Lanfear.
Available from Br. of Distr., USGS 604 S. Pickett St. Alexandria, VA 22304 $3.25. Geological Survey Professional Paper 1227, 1981. 40 p, 13 Fig, 10 Tab, 35 Ref.

Descriptors: *Oil spills, *Risks, *Water pollution sources, *Computer models, Model studies, Monte Carlo method, Simulation analysis, Probability distribution, Leases, Oil pollution, Environmental effects, Ecology, Water pollution control, Path of pollutants, Public lands, *Outer Continental Shelf.

The U.S. Geological Survey has developed an oilspill risk analysis model to aid in estimating the environmental hazards of developing oil resources in Outer Continental Shelf (OCS) lease areas. The large, computerized model analyzes the probability of spill occurrence, as well as the likely paths or trajectories of spills in relation to the locations of recreational and biological resources which may be vulnerable. The analytical methodology can easily incorporate estimates of weathering rates, slick dispersion, and possible mitigating effects of cleanup. The probability of spill occurrence is estimated from information on the anticipated level of oil production and method of route of transport. Spill movement is modeled in Monte Carlo fashion with a sample of 500 spills per season, each transported by monthly surface current vectors and wind velocities sampled from 3-hour wind transition matrices. Transition matrices are based on historic wind records grouped in 41 wind velocity classes, and are constructed seasonally for up to six wind stations. Locations and monthly vulnerabilities of up to 31 categories of environmental resources are digitized within an 800,000 square kilometer study area. Model output includes tables of conditional impact probabilities (that is, the probability of hitting a target, given that a spill has occured), as well as probability distributions for oilspills occurring and contacting environmental resources within preselected vulnerability time horizons. (USGS)
W82-06145

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,
Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
For primary bibliographic entry see Field 5G.
W82-06147

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W82-06150

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
J. I. Waddington.
Water Pollutiion Control, Vol 80, No 2, p 149-162, 1981. 2 Tab, 21 Ref.

Descriptors: *Water pollution control, *Planning, Environmental protection, *Mediterranean Sea, Mediterranean Action Plan, International agreements, International commissions, Organizations, International law, Legal aspects, International waters.

By the year 1965 it was clear that many coastal reaches along the Mediterranean Sea were rapidly becoming affected by increasing pollution levels. Efforts to prevent further deterioration of the area were needed, along with significant steps to improve the situation. A great range of activities is now in progress at local, national, and international levels, having been catalyzed by the Mediterranean Action Plan. The plan was outlined less than six years ago at the Barcelona Convention. The political will to cooperate in safeguarding the resources of the Mediterranean has been amply demonstrated, and there are more solid grounds for optimism than would have seemed possible only a short time ago. A monitoring program is being carried out by networks involving 84 research centers in 16 Mediterranean states. Eleven components of this program were carried out in 1975-1980, including studies on monitoring of petroleum hydrocarbons, heavy metals, and chlorinated hydrocarbons; effects of pollutants, coastal pollutant transport, role of sedimentation, and pollutants from land-based sources. A priority action program is being implemented. (Baker-FRC)
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,
Louisiana Water Resources Research Inst., Baton Rouge.
S. M. Crane, and R. F. Malone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243742, Price codes: A07 in paper copy, A01 in microfiche. Report, June 1982. 123 p, 10 Fig, 7 Tab, 62 Ref, 8 Append. OWRT B-014-LA(1).

Descriptors: *Model studies, *Biochemical oxygen demand, *Streams, *Kinetics, *Statistical analysis, *Probabilistic process, Computer models, Mathematical studies, Mathematical models, Predictin, Statistical methods, Statistical models, Monte carlo method, Stochastic process, Water quality management, Water quality standards, Oxidation ponds, Effluent seepage.

Nineteen sets of observed biochemical oxygen demand (BOD) data were collected from a low-flow southern stream which received an oxidation pond effluent. These data were used to assess the predictive reliability of a modified BOD model (Dobbins) for the stream environment. A strong correlation was found between chlorophyll-a (an indicator of algal productivity) and BOD, indicating that most of the BOD was in the form of algae from the upstream pond discharge. The modified model, however, predicted BOD stream values unreliably. The stabilized value of the standard error (SE) of prediction was 5.9 mg/liter (44% of the mean BOD value), based on a simulation experiment using 12 calibration data sets. The Monte Carlo method and split-sample testing were used to assess model performance in the calibration and verificatin phases, with stochastically-converged values of the SE of estimate and prediction used as statistical measures of model performance in each phase, respectively. The amount of data was a critical factor for model calibration, but not for model verification. It was concluded that probabilistic models of BOD in streams are better suited for use in making water quality management decisions. (Zielinski-MAXIMA)
W82-06159

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Biology.
For primary bibliographic entry see Field 5C.
W82-06165

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,

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Arkansas Univ., Fayetteville. Water Resources Research Center.
D. M. Chittenden, II.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254939, Price codes: A03 in paper copy, A01 in microfiche. Publication No 81, December 1981. 38 p, 7 Fig, 4 Tab, 18 Ref, 4 Append. OWRT A-050-ARK(1), 14-34-0001-0104.

Descriptors: *Radioactive wastes, *Nuclear reactors, *Cooling water, Adsorption, Water pollution sources, Nuclear power plants, Cooling, *Cesium radioisotopes, *Strontium radioisotopes, Cerium, Lake sediments, Suspended sediments, Alkaline-earth metals, Radiochemical analysis, Radioactivity techniques, Reservoirs, *Arkansas, Dardanelle Lake.

Concentration variations for strontium 90 (Sr90) and cesium 137 (Cs137) were analyzed at four stations in the Dardanelle Reservoir as functions of two parameters: the concentration of ionic species; and the activity released (AR) from the two 900 Mw reactors which use the Reservoir as a coooling water source. Multiple regression analyses were performed on the radionuclide concentrations using these two parameters as predictors. The results indicated that Sr90 is in equilibrium between solution and the suspended sediment, with the equilibrium position sensitive to changes in alkaline earth cation (M-II) concentrations. Hence, the M-II concentration has a substantial effect on Sr90 removal from the water column. On the other hand, the Cs137 concentration varied with AR, indicating that solution-sediment equilibrium has not been attained (since the time for newly-released Cs137 to equilibrate is greater than the mean water residence time in the Reservoir. Further, the Reservoir occurrence of cerium (Ce144 - praseodymium 144 seems a consequence of reactor refueling/maintenance, with Ce141 (and Ce144) derived from an airborne source with runoff to the Reservoir. (Zielinski-MAXIMA)
W82-06169

TRANSPORT OF PCBS IN AQUATIC LABORATORY MODEL ECOSYSTEMS FROM SEDIMENT TO THE ATMOSPHERE VIA THE SURFACE MICROLAYER,
Lund Univ. (Sweden). Limnological Inst.
A. Sodergren, and P. Larsson.
Ambio, Vol 11, No 1, p 41-45, 1982. 3 Fig, 8 Tab, 30 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Sediment-water interfaces, *Tubificids, *Midges, Aquatic animals, Lakes, Eutrophic lakes, Model studies, Anaerobic conditions, Particulate matter, Atmosphere, Jet drops, Surface microlayer, Sediment gas, *Sweden.

The effects of bottom-living organisms and anaerobic conditions on the distribution of PCBs in aquatic model ecosystems consisting of Chironomous plumosus and Tubifex sp. were studied. Sediment and water from the eutrophic Lake Havgardssjon in Sweden were incubated at 5 C and at 18 C with 2,3,4,4'-tetrachlorobiphenyl, 2,3',4,4'5-pentachlorobiphenyl and Clophen A 50, with the Clophen A 50 injected 5 mm (5 C) or 20 mm (18 C) below the sediment surface. Results showed a transport of PCBs to overlying water both in systems containing macroorganisms and in anaerobic systems. The presence of particles determined the amount of PCBs detected in the water. PCBs were taken up from sediment and accumulated in the macroorganisms. The accumulation was more pronounced when chironomids and tubificids were incubated together. PCBs left the water by jet drops and were recovered 7 cm above the water surface in all but fixed systems, the lowest amounts recorded being from undisturbed sediment cores. A similar pattern in anaerobic systems was caused by gas that developed in the sediment. The surface microlayers also contained PCBs, with the highest levels in very turbid anaerobic systems. PCBs moved toward the sediment surface in undisturbed cores incubated at 18 C. Incubation at 5 C rather than at 18 C produced a higher level of PCBs in water, animals, surface microlayer and jet drops. Surprisingly low amounts of PCBs were released to the water when injected at 20 mm, though low amounts were used. If these results apply to field conditions, the sediment may act as a source rather than a sink. (Gish-FRC)
W82-06180

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,
Mathes (John) and Associates, Inc., Columbia, IL.
For primary bibliographic entry see Field 5G.
W82-06185

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 2K.
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
P. A. Yeats, and J. M. Bewers.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 982-992, May, 1982. 2 Fig, 6 Tab, 45 Ref.

Descriptors: *Heavy metals, *Rivers, *St. Lawrence River, Path of pollutants, Aluminum, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Magnesium, Calcium, Silicon, Sediments, Canada.

Measurements of the dissolved and particulate forms of aluminum, iron, manganese, cobalt, nickel, copper, zinc, and cadmium made during a two year period at the mouth of the St. Lawrence River are reported. The sampling site was just upstream of the landward limit of salt intrusion. Some of the measurements taken were used to estimate metal fluxes for the purpose of determining the oceanic residence times of trace metals. Variability in the concentration of the dissolved metals was unrelated to changes in water flow or suspended load. Particulate Al, Fe, Mn, and Zn concentrations were related to water flow. The metal/aluminum ratios of particulate Mn, Cu, Zn, and Cd were elevated with respect to crustal rocks or coastal marine sediments, with the enrichment occurring in the nondetrital, or weak acid soluble, fraction. Annual dissolved metal discharges and nndetrital and total particulate metal discharges that take into account monthly variations in metal concentrations have been calculated for the St. Lawrence River. These calculated discharges are compared with estimates based on other rivers. The importance of nondetrital particulate metal fluxes is emphasized by these findings. (Baker-FRC)
W82-06190

RETENTION OF RIVERINE IRON IN ESTUARIES,
Maine University at Orono, Walpole.
L. M. Mayer.
Geochimica et Cosmochimica Acta, Vol 46, No 6, p 1003-1009, June, 1982. 7 Fig, 29 Ref.

Descriptors: *Estuaries, *Iron, Rivers, Seawater, Mixing, Maine, Salinity, Flocculation, Suspended sediments, Tannery effluents, Bottom sediments, Path of pollutants, Chemistry of precipitation, Chemical composition, Gulf of Maine, Canada.

Both the dissolved and particulate iron concentrations were examined in a series of estuarine water parcels, under low turbidity conditions, to determine whether iron removed from a filtrable state was actually lost from the water parcel. The potential roles of gravity and suspended sediment in removing iron from water parcels were examined by experimentation. The study area was the Gulf of Maine and three of itrs associated estuaries. The estuaries are all drowned river valleys, receiving freshwater runoff from watersheds similar in climate and vegetation. Riverine Fe was found to remain fairly conservative with salinity, implying that the process of flocculation does not necessarily remove Fe from water parcels. Laboratory experiments corroborated the field data by demonstrating that neither gravity nor suspended sediment was very effective in removing flocculated Fe from suspension. Input of a tannery effluent did appear to result in scavenging of Fe from estuarine waters. Flocculated riverine Fe was found to increase considerably the Fe concentrations of estuarine bottom sediments, with the amount of iron per sediment specific surface area dependent on mean river flow entering an estuary. While no long term retention efficiencies could be calculated for these estuaries, it seems likely that a significant portion of flocculated riverine Fe escapes to shelf waters. (Baker-FRC)
W82-06191

MERCURY CONTAMINATION OF THE LERDERDERG RIVER, VICTORIA, AUSTRALIA, FROM AN ABANDONED GOLD FIELD,
Monash Univ., Clayton (Australia). Dept. of Chemistry.
B. M. Bycroft, B. A. W. Coller, G. B. Deacon, D. J. Coleman, and P. S. Lake.
Environmental Pollution, Series A, Vol 28, No 2, p 135-147, 1982. 3 Fig, 5 Tab, 25 Ref.

Descriptors: *Mercury, *Mine wastes, *Gold, Rivers, *Australia, *Lerderderg River, Water pollution sources, Sediments, Fish, Path of pollutants, *Mine wastes.

This paper reports the distribution of mercury in water, sediments and fish from the Lerderderg River and the relationship between mercury levels and gold mining activities around Blackwood, where alluvial gold was first discovered in 1851. It has been at least 50 years since direct amalgamation was used routinely on the blackwood field. The Lerderderg River rises on the southern edge of the Great Dividing Range, about 110kkm northwest of Melbourne, Australia. State forest covers most of the catchment. The river flows in a southeasterly direction, passing through the settlements of Blackwood and Darley before joining the Werribee River. Recently a weir and a diversion tunnel were constructed on the river to divert water from the upper Lerderderg to Merrimu Reservoir, which supplies drinking and irrigation water to surrounding districts. Water, sediment and fish samples were collected from sites along the Lerderderg River and tributaries with sampling points focused around Blackwood. Mercury levels in water ranged from 0.01 to 0.31 micrograms/liter. Mercury levels in sediments ranged from less than 0.02 to 68.50 micrograms/gram dry weight, with an additional reading of 120.00 micrograms/g at a tailings sump on the bank of Yankee Creek. Mercury levels in brown trout ranged from 0.03 to 0.35 micrograms/g and for river blackfish, from 0.03 to 0.64 micrograms/g. The mercury levels in water samples showed no clear correlation with sampling sites. Sediment levels revealed a clear correlation with past mining activities. (Baker-FRC)
W82-06194

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,
North Dakota State Univ., Fargo. Dept. of Bacteriology.
For primary bibliographic entry see Field 5D.
W82-06195

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,
Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.
B. J. Richardson, and J. S. Waid.
Search, Vol 13, No 1/2, p 17-25, February/March, 1982. 3 Fig, 6 Tab, 50 Ref.

Descriptors: *Waste disposal, *Hazardous materials, *Polychlorinated biphenyls, *Australia, Organic compounds, Incineration, Waste dumps, Environmental effects, Mining industry, *Water pollu-

tion sources, Ports, Bays, Mussels, Sediments, *Path of pollutants.

The major routes of environmental entry of polychlorinated biphenyls (PCBs) include vaporization from open burning or incomplete incineration of solid wastes, and from paints, coatings and plastics; leaks and disposal of industrial fluids by improper means, including contamination of sewage which may ultimately be dumped at sea or on land; disposal on dumps and landfills, with subsequent leaching and volatilization; and inclusion in pesticides. In Australia the use of PCBs as hydraulic fluids in the mining industry is allowable, dispite risks of escape, especially in the marine situation such as drilling on coral reefs. The available evidence for the presence of PCBs in soils, sedimens and waters in Australia is very meager. The distribution of PCBs in sediments, fish and molluscs from Australian coastal waters is under investigation. In 1978 it was noted that PCBs had been found in mussels taken from Corio Bay. Mussel samples were then taken from Port Phillip and Corio Bay, with the result that PCBs were present in every sample, highest concentrations being found in localities adjacent to industrial activity or with heavy shipping traffic. The results of sediment analysis reinforced the mussel data. The greatest potential threat lies in delay in tackling the problem of finding efficient ways to destroy PCBs. A large quantity of PCBs awaits disposal under inadequate storage methods. (Baker-FRC)
W82-06232

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman, T. B. Ridder, H. F. R. Reijnders, and J. Slanina.
Water, Air, and Soil Pollution, Vol 17, No 4, p 415-420, 1982. 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Chemical composition, *Rain, Birds, Contamination, Chemical analysis, Phosphates, Nitrates, Potassium, Ammonia, Sampling, Precipitation, *Netherlands, *Pollutant identification.

Problems caused by bird-droppings in precipitation chemistry experiments in the Netherlands are discussed. Two specific projects are discussed, each of which used a collector consisting of a polyethylene funnel. The rim of the funnel was at 1.50 meters above the ground and the internal diameter was 22.3 cm. Each day during sampling for one of the projects the samplers were inspected for bird excrement, which was then carefully removed and the funnel cleaned with demineralized water. Even so, bird excrement may enter the bottle without being noted, particularly during rainy weather. In the two year period of the study, a total of 67 bird-droppings were counted. In the autumn of 1978 the samplers were equipped with a bird scarer device which did cut down on the number of droppings recorded. During the second project the collection bottles were changed once a week, the number of bird-droppings was counted and the collector was carefully cleaned. The pH of the rainwater was influenced by the droppings; in all cases except one the samples became more alkaline. An analysis of six bird-droppings revealed that the chemical composition of the rainfall collected is influenced most heavily in the amount of phosphates, potassium, and ammonia present. In some cases nitrates can also be influenced. To check on the possible occurrence of bird-droppings it is suggested that the phosphate content of the precipitation samples be checked. (Baker-FRC)
W82-06245

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W82-06269

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06270

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,
Northern Michign Univ., Marquette. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,
Alberta Univ., Edmonton. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06272

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. D. Brock, D. R. Lee, D. Janes, and D. Winek.
Water Research, Vol 16, No 7, p 1255-1263, July, 1982. 2 Fig, 8 Tab, 18 Ref.

Descriptors: *Cycling nutrients, *Groundwater, *Lakes, Nitrogen, Ammonia, Phosphorus, Eutrophication, Lake Mendota, *Wisconsin, Drainage area, Intersitial water.

Results of the first pore water nutrient assays at locations of known groundwater inflow in a lake are presented. Seepage water was assumed to be equivalent to the sediment pore water in the sediments lying just below the sediment-water interface. Lake Mendota has a fairly regular shoreline, and its shallow sediments are composed of sand which is fairly uniform. A total of 107 separate measurements at different locations were made around the Lake and used to calculate seepage rate. A total of 20 separate samplings for chemical analysis of seepage water were done at 11 separate sites around the lake. Phosphorus concentrations in seepage water varied from a low of 10 to over 500 micrograms/liter. Nitrate values varied from about 50 to 1000 micrograms/liter of nitrate-N. Ammonia values ranged from a low of 50 to a high of 400 micrograms/liter ammonia-N. These findings indicate that groundwater can be a significant source of water to a drainage lake, accounting for about 1/3 of the inflowing water in Lake Mendota. Groundwater can also be a route of nutrient loading to a drainage lake, especially for P. Seepage was continuously high in P and ammonia and lower in nitrate than well, spring or surface water, suggesting that the P and ammonia of seepage might be derived from the lake itself rather than from the surrounding land. (Baker-FRC)
W82-06285

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,
North West Water Authority, Warrington (England).
F. Jones.
Water Science and Technology, Vol 14, No 3, p 61-70, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Bacteria, *Ocean dumping, *Sludge disposal, Fate of pollutants, Water pollution sources, Wastewater disposal, Self purification, Coliforms, Fylde Coast, Liverpool Bay, North Wirral, Beaches, Outfalls, *England.

Bacterial concentrations in marine waters receiving sewage sludge were documented at three locations in northwest England. Untreated sewage discharged through the 3-mile North Wirral outfall at Meols did not cause high bacterial levels at beaches in the immediate area. Total coliforms ranged from 1000-585- per 100 ml at six stations about 9 km east of the outfall to 10-220 per 100 ml at the other 15 stations closer to the outfall. Offshore samples ranged from 7120 per 100 ml total coliforms at the outfall to 40-39- per 100 ml at distances 1 and 2 km on all sides of the outfall. In Liverpool Bay total coliforms were 27 per 100 ml at the ship dumping site and 13,580 per 100 ml at the mouth of the River Mersey. Six outfalls along a 25 km stretch of coast produced high and variable bacterial levels (1000-114,000 per 100 ml) at beaches at Fleetwood near the River Wyre. In this area occasional high turbidity greatly inhibits the natural purification process. (Cassar-FRC)
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,
Camp, Dresser and McKee Inc., Boston, MA.
For primary bibliographic entry see Field 5E.
W82-06289

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5C.
W82-06304

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,
Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
D. T. Pentek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256512, Price codes: A04 in paper copy, A01 in microfiche. MA Thesis, May 1981. 57 p, 72 Ref. OWRT B-017-CT (1).

Descriptors: *Ozonolysis, Polyhalogenated aromatic compounds, *Dibenzofuran, Industrial wastes, *Chemical wastes, Effluents, Oxidation, Wastewater treatment.

Ozonolyses of dibenzofuran were carried out in methylene chloride with reductive work up at -23 C, O C and 14 C, and in water at 14 C. Pseudo first order and second order rate constrants were calculated for all reactions. The second order rate constant in water was k sub 2(H O) = 1000M(-1)s(-1) and in methylene chloride was k sub 2 = 0.88M(-1)s(-1). The three orders of magnitude difference is thought to be caused by a competing free radical mechanism for dibenzofuran occurring in water. Oxidation products identified from the ozonolysis of dibenzofuran in methylene chloride were: salicylic acid, carbon dioxide, glyoxal, formaldehyde, and oxalic acid. A percentage of 40 of the initial carbon present in dibenzofuran is accounted for. The major product is salicylic acid and the major pathway for ozonolysis of dibenzofuran proceeds through salicylic acid. A total of 3.5 mmole ozone/mmole dibenzofuran was required to degrade 99% of the dibenzofuran present (in methylene chloride).
W82-06305

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and E. A. Leggatt.
Water Research, Vol 16, No 7, p 1217-1222, July, 1982. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Water quality, *Bacteria, Lakes, Recreational facilities, Coliforms, Fecal bacteria, Bioindicators, Pollutant identification, Indicators, Canada, *Ontario.

Present bacteriological water quality was documented for a number of developed recreational lakes and for one undeveloped lake in the Ontario area. This was achieved by determining the density and distribution of fecal bacteria and the location and sources of major inputs of fecal indicator bacteria in these lakes. Lakes were surveyed for 5 consecutive days, in the spring, summer and often the fall of the year, at inflows, outflows and a

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number of locations representative of shoreline features and development. Fecal coliform and fecal streptococcus levels in the 18 developed lakes samples varied in a seemingly erratic way. When the bacterial densities at different points on the lake were examined by an analysis of variance, the locations with significantly higher densities of fecal coliforms and fecal streptococci were most often along the cottaged shoreline. Total coliform densities did not show this relationship. In addition, after rainfall, a large increase in the numbers of fecal coliforms were found in the cottaged lakes but not in the uncottaged lake. These findings suggest that the cottaged shoreline was a greater source of fecal indicator bacteria than the uncottaged shoreline. However, the highest concentrations of fecal indicator bacteria in these lakes were found in the inflowing streams. The bacteria in these streams arose from stormwater from undeveloped forested watersheds and were probably of soil or animal origin. (Baker-FRC)
W82-06310

ACID RAIN MODEL: HYDROLOGIC MODULE,
Tetra Tech. Inc., Lafayette, CA.
C. W. Chen, J. D. Dean, S. A. Gherini, and R. A. Goldstein.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 455-472, June, 1982. 12 Fig, 5 Tab, 22 Ref.

Descriptors: *Acid rain, *Model studies, Watersheds, Catchment areas, Drainage area, Basins, Percolation, Chemical analysis, Lakes, Chemical reactions, Evapotranspiration, Freezing, Snowmelt, Melting, Hydrology, Hydrologic models.

An Integrated Lake-Watershed Acidification Study (ILWAS) model is presented and findings based on simulation applications of the model to date are evaluated. The ILWAS model includes hydrologic, canopy chemistry, snowmelt chemistry, soil chemistry, and stream and lake water quality modules. For modeling purposes a drainage basin is divided into terrestrial subcatchments, stream segments, and a lake. Vertically, each subcatchment is further segmented into canopy, snow pack, and soil layers. The lake is also vertically layered. All these physical compartments are coupled to form a network that allows water to be routed through the system to the lake outlet. The physical compartments are described by geometric input parameters such as area, aspect, slope, and soil layer thickness. Subcatchments are allowed to have different percentage distributions of deciduous and coniferous trees and open areas. The hydrologic module of the ILWAS model realistically simulated the total outflow from a lake basin and the hydrology of the subcatchments. The flowpath calculations are supported inn part by observations of the soil solution and lake water pH values. The flowpaths of rain and snowmelt water through the terrestrial system are important factors in determining the susceptibility of lakes to acidification by atmospheric deposition. Several mechanisms can force rain and snowmelt water to become lateral flow in the upper soil horizons instead of percolating into the inorganic horizons.Low hydraulic conductivity in any soil layer may result in lateral flows in overlying layers. (Baker-FRC)
W82-06360

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,
Vermont Water Resources Research Center, Burlington.
For primary bibliographic entry see Field 5G.
W82-06372

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 205, March, 1980. 44 p, 1 Fig, 19 Tab, 6 Ref.

Descriptors: *Trace metals, Water analysis, *Water pollution sources, *Sediment-water interfaces, Heavy metals, Pollutants, Pollutant identification, Estuaries, *South Africa, Rivers, Nonpoint pollution sources, Toxicity, Chemical analysis, Water quality, Sediments, Metals, Water quality control, Cores, *Path of pollutants.

Trace metal surveys were conducted during July 1978 on three estuaries which enter the Indian Ocean in Mossel Bay. Surface sediment, water, and sediment core samples were collected at selected sites in each river for trace metal analyses (13 elements for water samples; 16 elements for all other samples) by atomic absorption spectroscopy. Inter-element relationships and absolute metal concentrations were examined before interpreting the resultant data. The results indicate that all three rivers experience some degree of metal contamination. However, with the exception of the extremely high chromium levels (containing up to 1.13% chromium) found in sediment in part of one river (Great Brak) from an unknown source, trace element concentrations were found not to represent a significant pollution threat; nonetheless, monitoring should be continued. All three rivers exhibited some indications of other than natural metal buildup. The chromium anomaly will be resurveyed in more detail for potential source identification. Remobilization of the chromium contamination via flooding could induce mass mortality of local flora/fauna. Trace element concentrations are given for all sample types and correlation matrices are given for the core samples. (Zielinski-MAXIMA)
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 2L.
W82-06388

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,
Karlsruhe Univ. (Germany, F.R.).
W. Rodi, and K. Weiss.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 737-746, June, 1982. 7 Fig, 4 Ref.

Descriptors: *Heated water, *Thermal pollution, *Mixing, Fate of pollutants, Flow characteristics, Open channel flow, Water temperature, Buoyancy.

Heated water was discharged coaxially into rectangular open channel flow from a slot placed at the channel center. The discharge and channel velocities were the same. The temperatures studies were 9 and 20 C in excess of ambient. Temperature distribution was determined by thermistors, and surface motions was recorded by photographing surface floats. Several effects associated with the density differences between heated and ambient water were visible. The warm water spreading at the surface formed a warm surface layer and isolated warm water pools. Colder ambient water was drawn toward the center plane to replace the warm water. The warm water spreading at the surface formed a sharp straight front with an angle to the center line that increased with increasing density differences. The warm surface layer dampened the turbulent mixing with the colder water, so the isolated warm water pools stayed hot for considerable distances from the discharge. The flow geometry investigated here was simple enough to use as a test case for calculation procedures simulating buoyancy effects on mean flow and turbulent mixing. (Cassar-FRC)
W82-06422

GROUNDWATER POLLUTION FROM INDUSTRIAL WASTE DISPOSAL, A CASE STUDY,
Saint Lawrence Univ., Canton, NY.
G. R. Harris, C. Garlock, L. LeSeur, S. Mesinger, and R. Wexler.
Journal of Environmental Health, Vol 44, No 6, p 287-295, May/June, 1982. 10 Fig, 7 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Waste disposal, *Water pollution sources, *Land disposal, *Leaching, *Groundwater movement, Waste management, Wastes, Industrial wastes, Geohydrology, Soil types, Leachates.

An organic and inorganic waste disposal pit operated by Sealand Restoration Incorporated (SRI) of Oswego, New York, was improperly constructed and violated state permits. The pit was not lined with impermeable materials, and an underlying groundwater interception ditch was too shallow, resulting in area groundwater pollution. Following periods of high precipitation, migration of leachate was observed at downgradient sampling sites. Minimum geologic and hydrologic considerations for industrial waste disposal sites include soil type, depth to groundwater and bedrock, slope, and distance to surface water. According to these criteria, the existing disposal pit was found to have severe limitations for the disposal of industrial wastes. Investigations into the suitability of other SRI sites for waste disposal were inconclusive due to insufficient characterization of soil and land properties. (Geiger-FRC)
W82-06434

EXAMINATION OF PROBABLE CAUSES OF INDIVIDUAL WATER SUPPLY CONTAMINATION,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
W. S. Brewer, and J. Lucas.
Journal of Environmental Health, Vol 44, No 6, p 305-307, May/June, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Coliforms, *Groundwater pollution, *Aquifers, *Infiltration, *Wells, Fate of pollutants, Water pollution sources, Percolation, Groundwater recharge, Water supply, Mathematical studies, Surveys.

A previous study of water supply records from 1972-1975 in a rural county in Ohio revealed a correlation between the probability of contamination and the location of wells with respect to their supply aquifers. To test the validity of the hypothesis that contaminated aquifers were the cause of high coliform levels in wells, county records from 1978-79 were surveyed to determine the extent of contaminated wells in each of two aquifers serving the county. Of the 613 wells surveyed, 113 wells were found to have coliform counts greater than 1 colony/100 milliliters. Comparison of contamination rates showed that one aquifer was more likely to contain contaminated wells than the other, but efforts to establish a causal relationship were unsuccessful. Analysis of variance showed that the formations overlying the well (depth, consolidated or unconsolidated strata, surface water infiltration rate) exerted a stronger influence on the outcome of the study than did the aquifer correlation. A cause-effect relationship was proposed between insufficient filtration of percolating surface water and contamination. (Geiger-FRC)
W82-06435

NOMOGRAPHS FOR RAPID SOLUTIONS FOR THE STREETER-PHELPS EQUATIONS,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Div.
G. B. McBride.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 378-384, April, 1982. 5 Fig, 7 Ref.

Descriptors: Mathematical equations, *Nomographs, *Rivers, *Water pollution sources, Biochemical oxygen demand, Dissolved oxygen, Mathematical models, Prediction, *Streeter-Phelps equations, *Path of pollutants.

Nomographs have been developed which allow rapid calculation of the worst effects of emergency discharges for rivers for which a convenient operational model does not already exist. The nomographs are based on the equations of the Streeter-Phelps model, which allow calculation of the concentrations of river biochemical oxygen demand (BOD) and river dissolved oxygen deficit (DOD) downstream of some initial point at which BOD

and DOD values are known. Solutions for the location and magnitude of the maximum downstream river DOD are presented in simple nomograph form. A nomograph for calculation of the maximum permissible initial river 5-day BOD given the initial river DOD and the maximum permissible downstream DOD is also presented. The use of these nomographs involves three simple steps: the formation of three dimensionless ratios, the reading of a nomograph, and the calculation of the required answer by a simple arithmetic formula. Use of the nomographs requires the following data: initial river DOD in grams per cubic meters the BOD decay coefficient evaluated for the standard laboratory BOD test, the river deoxygenation coefficient, and the river reaeration coefficient. The nomographs can only be strictly applied to rivers which comply with the requirements of the Streeter-Phelps model, although they will provide reasonable predictions for most rivers when rapid and approximate answers are required. (Carroll-FRC)
W82-06460

PCB UPTAKE BY FIVE SPECIES OF FISH IN LAKE MICHIGAN, GREEN BAY OF LAKE MICHIGAN, AND CAYUGA LAKE, NEW YORK,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen, S. A. Spigarelli, and M. M. Thommes.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 700-709, May, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Fate of pollutants, Model studies, Fish, *Uptake, *Polychlorinated biphenyls, Trout, Salmon, Whitefish, *Lake Michigan, Absorption, Accumulation, Metabolism, Habitats, Kinetics, Path of pollutants, *Green Bay, *Cayuga Lake, Wisconsin, New York.

A bioenergetic model was used to describe the uptake of polychlorinated biphenyls (PCBs) by trout, whitefish, and salmon of Lake Michigan and trout of Cayuga Lake in New York. PCB uptake was defined in terms of metabolism, food consumption, size, and growth. PCB levels differed significantly among species according to habitat. PCB was taken up by brown trout in a pattern distinct from that of other species. An increase in the exponent of weight for metabolism changed the shape of the relation between PCB concentration and body weight from asymptotic to non-asymptotic. In all species tested except brown trout, PCB uptake was not asymptotic and concentrations did not approach equilibrium. Simulation analyses showed that differences in PCB levels among species and in the same species among different habitats were most likely due to differences in metabolic parameters, exposure, size, and rate of growth. (Geiger-FRC)
W82-06493

ENRICHMENT OF INORGANIC NUTRIENTS IN THE INNER SARONIKOS GULF (1973-1976),
Institute of Oceanographic and Fisheries Research, Athens (Greece).
M. Friligos.
Marine Pollution Bulletin, Vol 13, No 5, p 154-158, 1982. 1 Fig, 7 Tab, 11 Ref.

Descriptors: *Nutrients, *Wastewater pollution, Fate of pollutants, Water pollution sources, Saronikos Gulf, Elefsis Bay, *Greece, Outfalls, Nitrates, Nitrites, Ammonium, Silicates, Phosphates, Wastewater disposal, Ocean disposal, Wastewater outfall.

Waters in the Inner Saronikos Gulf and Elefsis Bay, near Athens, Greece, were sampled during 16 cruises January 1973 to September 1976. The semi-enclosed Gulf is 70-90 m deep in the eastern main body and 130-400 m deep in the western portion. An outfall discharges raw sewage from the Athens metropolitan area into the sea water of the Inner Gulf. The 30 m deep Elefsis Bay, at the north end of the Gulf, is connected by two narrow and shallow channels to Keratsini Bay and the Saronikos Gulf. It is polluted with industrial effluents and sewage. Background levels (in micrograms atoms per liter) of nutrients in the relatively unpolluted Outer Bay were: phosphate-P, 0.12; silicate-Si, 1.22; nitrite-N, 0.16; nitrate-N, 0.42; and ammonium-N, 0.36. Concentrations of nutrients in the Inner Gulf were 2.5 times the background level for phosphate, 1.39 for silicate, 1.55 for nitrite, 2.60 for nitrate, 4.10 for ammonium, and 3.03 for total N. Elefsis Bay contained 9 times the inoganic N, 15 times the ammonia, 7 times the nitrates, 3 times the nitrite, 5 times the phosphate, and 4 times the silicate as the background. (Cassar-FRC)
W82-06499

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Artiola-Fortuny, and W. H. Fuller.
Soil Science, Vol 133, No 4, p 218-227, April, 1982. 4 Fig, 6 Tab, 22 Ref.

Descriptors: *Leachates, *Phenols, Landfills, Sanitary landfills, Organic compounds, Municipal wastes, Chemical reactions, Adsorption, Clays, Aeration, Humic acids, Fulvic acids, Fate of pollutants.

Municipal solid waste leachates contained varying amounts of natural phenols, depending on age. The youngest leachate, 1 year, was higher in acidity, total organic carbon, and electric conductivity (EC) than leachates aged 3 to 7 years. Over a 12 month sampling period all leachates decreased in total organic carbon. The youngest leachate increased in pH and EC, while the older leachates remained constant in pH and EC. Natural phenols migrated through 10 cm of clay soils in 7 pore volume displacements or fewer. Leachates of low pH and high total organic carbon moved rapidly through the soil. Phenols moved more slowly in fine textured, iron oxide-rich clays than in other soils. Leachates enriched with phenol, 2,6-dimethylphenol, o- and p-cresol, 2,4-dichlorophenol, and p-nitrophenol were more reactive with younger leachates than with older ones. The high level of humic and fulvic acids in younger leachates appeared to be correlated with the rapid reaction of phenols. Of all the phenols tested, the strongly polar nitrophenols were least reactive with leachates. Phenol levels were rapidly reduced by aeration of leachates. (Cassar-FRC)
W82-06518

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,
National Board of Waters, Helsinki (Finland).
R. M. Niemi, S. Knuth, and K. Lundstrom.
Applied and Environmental Microbiology, Vol 43, No 2, p 378-388, February, 1982. 8 Fig, 5 Tab, 28 Ref.

Descriptors: *Actinomyces, *Fungi, Thermophilic bacteria, Mesophytes, Water supply, Lakes, Rivers, Water treatment, Bacteria, Finland, Drinking water, Path of pollutants, Filtration, Disinfection, Artificial recharge, Groundwater pollution.

The occurrence of mesophilic and thermophilic actinomycetes and fungi in finnish lakes and rivers used as water supplies and in treated water and distribution systems was investigated. Mesophilic fungi and actinomycetes were common in Finnish lakes and rivers used as water supplies, while thermophilic fungi and actinomycetes were present only in low concentrations. Eutrophic and mesotrophic lakes had higher concentrations of fungi and actinomycetes than did oligotrophic lakes. Thermophilic actinomycetes and fungi and mesophilic actinomycetes were more abundant in river water than in lake water. The correlation between concentrations of actinomycetes and fungi and the chemical and physical parameters of the water, as well as the correlations between microbes and the percentage of cultivated land in the drainage basin, probably reflect the importance of runoff for the occurrence of these microbes in lakes and rivers under normal conditions. A comparison of the efficiencies of different water treatments in removing these organisms showed that while chemical coagulation removed actinomycetes and fungi efficiently, sand filtration sometimes contributed to the populations of thermophilic actinomycetes. Actinomycetes and fungi were present in many raw water supplies and were able to pass through both sand filtration and disinfection, resulting in the occurrence of these bacteria in drinking water. Also, mesophilic actinomycete concentrations were higher in artificial groundwater produced for groundwater recharge than they were in eutrophic raw water. (Carroll-FRC)
W82-06543

CORRELATIONS BETWEEN PREDOMINANT HETEROTROPHIC BACTERIA AND PHYSICOCHEMICAL WATER QUALITY PARAMETERS IN TWO CANADIAN RIVERS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Applied and Environmental Microbiology, Vol 43, No 2, p 269-283, February, 1982. 2 Fig, 13 Tab, 42 Ref.

Descriptors: *Heterotrophic bacteria, *Bacterial analysis, *Physicochemical properties, Water quality, Bacteria, Factor analysis, Population dynamics, Rivers, *Canada, Dunbar River, Meduxnekeag River, Saint John River, Water pollution effects.

A multivariate statistical analysis of data from two branches of the Saint John River in New Brunswick, Canada, was performed to investigate the interactions of the bacterial populations with the physicochemical parameters of the water. One of the branches, the Dunbar, is a pristine woodland stream, while the other, the Meduxnekeag River, is a larger stream receiving some domestic and agricultural wastewaters. The heterotrophic bacterial populations of the two streams were analyzed as total heterotrophic counts; as species numbers, using numerical taxonomy; by diversity indices; and by factor analysis. Factors which profiled the bacterial community and which were common to both rivers included, in order of decreasing importance, fermentative metabolism, inorganic nitrogen metabolism, fluorescence-oxidative metabolism, and lack of starch hydrolysis. The correlations found between the bacterial populations and physicochemical parameters of the water suggested an intricate algal-bacterial interaction. In one river, correlation of the oxidative metabolism factor with rainfall suggested that the oxidative bacteria may be washed into the river from the surrounding land. The oxidative-fermentative factor correlated negatively with sunshine in the second river. While factor analysis was found to be the most effective method for revealing correlations between bacterial characteristics and the environmental parameters, the use of a variety of methods provided more insight into the ecological apsects. (Carroll-FRC)
W82-06544

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
For primary bibliographic entry see Field 2L.
W82-06546

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,
Agriculture Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W82-06547

SELECTION OF WASTE DISPOSAL SITES,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W82-06550

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METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,
Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
S. A. Telang, B. L. Baker, J. W. Costerton, T. Ladd, and R. Mutch.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 101, 1982. 101 p, 66 Ref, 5 append.

Descriptors: *Marmot, basin, *Alberta, Rocky Mountains, *Biogeochemistry, *Organic compounds, Drainage, Basin, Stream basins, *Mountain basins, Water Quality, Stream organics, Organic loading, Streamwater, Stream flow, *Path of pollutants.

The Marmot basin is a mountain drainage basin in the eastern slopes of the Rocky Mountains 600 km north of the Canadian-United States border. It illustrates the hydrology of eastern slopes drainage. The present study focussed on biogeochemical processes occurring naturally in the waters of Marmot creek. These were revealed by measurements of the transport and conversion of organic substances in that cold, clear mountain stream just below the alpine tree-line. Naturally-occurring organic substances ranged widely in biogeochemical lability and afforded a comprehensive evaluation of the in-stream processes of change. Organic substances of the streams are in a dynamic state with marked processes of transfer and conversion discernible in a short, 2.2 km, section of the Marmot system even under winter conditions. Detailed calculations based on stream monitoring revealed the effects of those processes by comparing mass transport in and out of the 2.2 km test section. Processes of conversion and transport within the test section were apparent for each compound and group of compounds. Three different seasonal patterns of alterations are noted. Processes of change involve biosynthesis, maceration and leaching, oxidation, up-take, photodegradation, mineralization, absorption/desorption and biodegradation. Some processes were related to land disturbance, as in the case of forest clear-cutting; this modified contributions to the stream from soil leaching. At the biogeochemical frontiers, three new approaches involved adaptation of anlytical technologies from related disciplines; 1) carbon preference indices for n-alkanes in the stream water clearly showed in-stream biosynthesis of hydrocarbons in the low-molecular weight range and the leaching of terrestrial hydrocarbons in higher mass ranges; 2) heterotrophic-potential measurements carried out in-situ and in thelaboratory confirmed the up-take of labile organic compunds in the stream (attributed largely to sessile rather than planktonic microbes); and 3) analogue-depletion calculations showed the potential of this method for evaluating stream processes when stream gauging is not available. The adoption of naturally-occurring inorganic ions as reference substances in the stable-labile system of depletion led clearly to a sharp definition of in-situ depletion. It is now possible (a) to use heterotrophic-potential experiments to predict the depletion of a given microbial substrate in a stream depletion, without the addition of tracers or the gauging of the stream. (WATDOC).
W82-06569

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,
Canada Centre for Inland Water, Burlington (Ontario).
W. Boutot, and T. A. Clair.
Technical Bulletin No 121, 1981. 23 p, 5 Fig, 5 Tab, 7 Ref.

Descriptors: *St. Croix River, *New Brunswick, *Maine, *Hydraulic models, *Oxygen levels, Water quality, Mathematical models, Pollutant loads, Salmon migration, Calibration, Model simulation, Data analysis, *Dissolved oxygen.

Mathematical modelling techniques have been applied to study the dissolved oxygen concentration in the lower reach of the St. Croix River. A hydraulic routing model, HEC-2, was used to describe the flow regime, and the WATQUAL moddel was used to simulate dissolved oxygen levels under different conditions of temperature, flow and biological oxygen demand. The results indicate that waste loading to the river should be restricted during periods of high temperature and minimum river discharge in order to permit fish migration. (WATDOC)
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
V. T. Chacko, B. C. S. Chu, and W. D. Gummer.
Scientific Series No 128, 1981. 12 p, 10 Fig, 3 Tab, 17 Ref.

Descriptors: *Red River(of the North), *Saskatchewan, *Minnesota, *Load distribution, *Seasonal ratios, *Nitrogen, *Phosphorus, Nitrate concentrations, Amonia, Species, Runoff.

The Red River flows from the United States through Manitoba and into the south basin of Lake Winnipeg. Significant seasonal variations in nitrogen and phosphorus species, concentration and ratios occurred in the Red River during a study conducted at the border between Canada and the United States. Nitrate-N was as much as 60% of total-N during the spring high flow. During summer nitrate-N was so low that it might have been a limiting factor for phytoplankton growth (the inorganic-N to ortho-P ratio exceeded 10 on one occasion only). Particulate-N was usually less than 30% of total-N. Ammonia was up to 30% of total-N in February. The ortho-P concentration constituted between 25% and 80% of total-P. Dissolved organic-P never exceeded 16% of total-P, and particulate-P was as much as 70% of total-P. Particulate P:N:C ratios differed from the stoichiometric ratios of plant cells. On this basis, it is concluded that much of the particulate-P was in mineral form. (WATDOC)
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 72, 1981. 10 p, 2 Fig, 9 Tab, 4 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, Water quality control, Contamination, Spiked samples, Homogeneity, Pollutant levels, Interlaboratory studies, Statistical analysis, Data collections, *Path of pollutants, *Pollutant identification.

This report describes an interlaboratory study on the analysis of polychlorinated biphenyls (PCBs) in naturally contaminated dry sediment reference materials and in isooctane solutions. The quality of data submitted by the participants varied widely. Among the more comparable laboratories, the average interlaboratory coefficient of variation (C.V.) of the sediment samples is 29.0%. This result is significantly worse than the interlaboratory C.V. (16.2%) on sediment samples spiked with PCBs, as reported in interlaboratory quality control study No. 25. The less reliable PCB results, as found on real sediment samples, are likely due to problems in recovery, interference and quantitation of PCB mixtures. (WATDOC)
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06575

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5A.
W82-06577

EFFECTS OF PH, TEMPERATURE, AND EH ON THE UPTAKE OF CADMIUM BY BACTERIA AND AN ARTIFICIAL SEDIMENT,
Ohio State Univ. Columbus. Dept. of Microbiology.
J. A. Titus, and R. M. Pfister.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6 p 697-704, June, 1982. 2 Fig, 2 Tab, 8 Ref,OWRT A-042-OHIO Grant 712437.

Descriptors: *Fate of pollutants, *Adsorption, *Hydrogen ion concentration, *Sediments, *Pseudomonas, Path of pollutants, Temperature, Uptake, Heavy metals, *Cadmium, Conductivity, Water temperature, Oxidation-reduction potential, Laboratory studies.

Bacteria are known to facilitate the movement of heavy metals from sediment to the water column during their metabolic activities. Acid production by bacteria also aids in the breakdown of the sulfides of zinc (Zn), cadmium (Cd) and lead (Pb). The adsorption of Cd by a Cd-resistant bacterium (Pseudomonas sp.) and a sediment matrix under various conditions of pH, temperature and Eh (redox potential) was examined in four separate kettles. Uptake of Cd by the artificial sediment matrix in a water-sediment system was related to the incubation conditions in a manner similar to that found with bacteria. After 4 days at pH 7 and a temperature of 35 degrees, Cd adsorption was greatest by sediment and bacteria. Incubation at a higher pH lowered sediment adsorption, while lowering the Eh resulted in higher 2-day Cd adsorption by sediment. These effects were less pronounced in bacteria. The amount of Cd taken up by bacteria averaged about 10 times greater than that adsorbed by the sediment on a dry weight basis. These studies showed that the uptake of Cd by a Cd-resistant bacterium was influenced by environmental factors in the same manner as that by sediment. (Geiger-FRC).
W82-06580

RELATIONSHIP OF WATER QUALITY AND POLLUTANT LOADS TO LAND USES IN ADJOINING WATERSHEDS,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
R. C. Ostry.
Water Resources Bulletin, Vol 18, No 1, p 99-104, February, 1982. 1 Fig, 6 Tab, 3 Ref.

Descriptors: *Water quality, *Pollution load, *Land use, Water pollution sources, *Watersheds, *Ontario, Grand River, Sangeen River.

The Grand and Saugeen Rivers in southern Ontario, Canada, were selected for investigation as pilot watersheds under the Pollution from Land Use Activities Reference Group study. These watersheds, which have adjacent headwater areas, are physically similar in geology, physiography, and climate. Land use and population constitute the major differences between the two watersheds and appear to be responsible for the significant differences in water quality between the watersheds at their outlets. The major pollution sources in the two watersheds were identified as trace elements from urban runoff and point source discharges, phosphorus from agricultural and urban runoff and private waste disposal, chloride from transportation corridors, and sediment and nitrogen from agricultural runoff. Suspended sediment loadings were similar for the two watersheds at their outlets, while all other unit area loads were higher in the Grand River than in the Saugeen River. Phosphorus, nitrogen, chloride, and lead loadings were

two to three times as high in the Grand River as in the Saugeen River. The higher phosphorus and nitrogen levels in the Grand River were attributed to larger point source inputs and to the higher proportion of agricultural activity in the Grand River basin, while the higher chloride and lead levels were attributed to the higher proportion of urban lands in the Grand River basin as compared to the Saugeen River basin. (Carroll-FRC)
W82-06587

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,
Thames Water Authority, London (London).
For primary bibliographic entry see Field 5E.
W82-06592

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,
For primary bibliographic entry see Field 5E.
W82-06599

PROPORTION OF METHYLMERCURY TO THE TOTAL AMOUNT OF MERCURY IN RIVER WATERS IN CANADA AND JAPAN,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
A. Kudo, H. Nagase, and Y. Ose.
Water Research, Vol 16, No 6, p 1011-1015, June, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Mercury, Rivers, Natural waters, Wastewater, Water analysis, *Methylmercury, Fish, *Pollutant identification, Ions, *Canada, *Japan, Ottawa River, Nagara River, Suimon River.

The concentrations of methylmercuric ion mercuric ion, and the total amount of mercury in three rivers are discussed: the Suimon and the Nagara Rivers in Japan and the Ottawa River in Canada. The Nagara River is very clean, but the Ottawa and Suimon Rivers have been polluted by industrial effluents containing mercury. During the past several years these two rivers have been cleaned up. Total mercury concentrations were 19.3 and 25.9 ng/liter in the Nagara and Suimon rivers respectively and 6.6 ng/liter in the Ottawa River. The average methylmercury concentration for the Ottawa River was 2.2 ng/liter, with the average proportion of methylmercury to the total amount of mercury being 33%, very similar to the results for the Nagara and Suimon Rivers. Sewage effluent from Ogaki City contained 39.6 ng/liter total mercury, and the proportion of methylmercury in the effluent (29%) was close to that of the river waters, 30%. These high proportions of methylmercury relative to total mercury may explain why fish in clean rivers and lakes in Northern Canada contain high concentrations of mercury, most of which is in the form of methylmercury. (Baker-FRC)
W82-06609

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,
Texas Univ. at Houston. School of Public Health.
R. K. Guthrie, E. M. Davis, D. S. Cherry, and J. R. Walton.
Water Resource Bulletin, Vol 18, No 1, p 135-138, February, 1982. 4 Tab, 21 Ref.

Descriptors: *Electric power production, *Coal, *Water pollution sources, Environmental effects, Water Quality, Water reuse, Wastewater management, Waste management.

The use of coal in the United States has increased much more rapidly than was predicted since 1972, with electric power generating plants accounting for much of the increased use. Solid wastes generated by coal combustion include bottom and fly ashes, which consist primarily of inorganic materials. The majority of chemical elements present in coal are concentrated in the fly ash. The sulfate content of the fly ash lowers the pH of water with which it comes in contact, affecting the chemical and physical state of other elements present in the fly ash. Detrimental effects of coal ash effluent runoff in the aquatic environment may result from suspended solids, sedimentation, accumulation of heavy metals in different trophic levels, passage of some of the metals through food chains, and changes in pH and chemical balance. Proper construction and operation of ash settling basins can, however, control the detrimental effects of these effluents and may even result in improvement of the water quality parameters of the effluent as compared with the source water. Special attention must be paid to the solubility or deposition in sediment of potentially toxic chemical elements from fly ash. This study suggests that the aquatic environment need not be adversely affected by solid waste materials from coal combustion and that the potential effects of reuse of effluent water from ash settling basins should be investigated. (Carroll-FRC)
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5G.
W82-06624

NONPOINT SOURCE LOADING RATES FROM SELECTED LAND USES,
Wisconsin Univ.-Madison. Dept. of Soil Science.
T. C. Daniel, R. C. Wendt, P. E. McGuire, and D. Stoffel.
Water Resources Bulletin, Vol 18, No 1, p 117-120, February, 1982. 2 Fig, 17 Ref.

Descriptors: *Nonpoint pollution sources, *Pollution load, *Land use, *Runoff volume, Phosphorus, Barn wastes, Dairy industry, Construction, Industrial wastewater, Water pollution sources.

Nonpoint source loading rates derived from monitoring natural runoff from selected land uses in a dairying watershed were compared in an effort to identify priority problems. Runoff volumes, sediment, and nutrient fractions from construction sites, barnyards, and dairying were monitored and expressed as areal loadings for comparison purposes. Sediment yield and total phosphorus loss was found to be directly proportional to runoff, with construction sites having the highest levels and general dairying the lowest. Runoff from barnyard areas had soluble phosphorus and ammonium nitrogen concentrations about 10 times higher than those of the other land uses investigated. Areal loss from nitrate nitrogen was highest from the construction site and was attributed to the higher volume of runoff per unit area. The results of this study show that barnyards in a dairying watershed contribute the highest areal loadings of sediment and nutrients, and especially of dissolved nutrients having the potential for such immediate adverse effects on water quality as rapid algae blooms and aquatic weed growth. Although the runoff and sediment yields were higher from the construction site, the dissolved phosphorus and ammonium nitrate loadings were low. Dairying activity showed the lowest sediment yield of the land uses investigate, reflecting the high amount of land area protected by cover crops. The particular effects of individual sites on water quality will also depend on proximity to surface water bodies and on other watershed characteristics affecting the delivery ratios of contaminants. (Carroll-FRC)
W82-06626

QUALITY OF STORMWATER RUNOFF FROM MOTORWAYS (DIEBESCHAFFENHEIT DER NIEDERSCHLAGSABFLUSSE VON AUTOBAHNEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergute- und Abfallwirtschaft.
H. Klein.
Wasserwirtschaft, Vol 72, No 2, p 37-43, February, 1982. 6 Fig, 6 Tab, 12 Ref. English Summary.

Descriptors: *Storm runoff, *Roads, *Pollutant identification, *Rainfall-runoff relationships, Precipitation, Pollutants, Heavy metals, Chlorides, Highways, Wastewater treatment, Drains, Storm drains, *West Germany, Runoff, Traffic, Water pollutant sources.

The quality of stormwater runoff from road surfaces was examined along three stretches of heavily-trafficked highway in West Germany. Routes A 81 and A 6 are flanked by high rims so that runoff is collected exclusively in storm drains, whereas Route A 8/B 10 has a grass verge over which runoff flows before entering a drain containing a sump. While median monthly rainfall was similar for all three roads, mean monthly runoff varied (599, 358, and 178 cu m/hectare for A 81, A 6, and A 8/B 10, respectively). This was attributed mainly to the difference in drainage systems. Annual mean concentration of chloride was 50-500 times greater in runoff than in rainwater collected at the same sites. Of all filterable material collected, only 4-7% originated in rain. Compared with discharge from a mechanical/biological sewage treatment plant, runoff contained significantly higher concentrations of most pollutants: a maximum of twice as much COD and cadmium, up to five times as much lead, copper, and zinc, up to 17 times as much filterable material, and 50-60 times as much polycyclic hydrocarbons. Smaller amounts of ammonium nitride and total phosphorus were present in runoff. Almost all runoff samples exceeded the maximal permissible limits for filterable material, iron, COD, mineral oil, and chloride. With the exception of chloride, pollutants were found in lesser amounts in runoff from Route A 8/B 10 than in that from the other two roads due to runoff permeating the grass verge. (Gish-FRC)
W82-06635

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),
Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
For primary bibliographic entry see Field 5E.
W82-06637

CADMIUM IN GAMMARIDAE (AMPHIPODA: CRUSTACEA) OF THE RIVERS WERRA AND WESER-II. SEASONAL VARIATION AND CORRELATION TO TEMPERATURE AND OTHER ENVIRONMENTAL VARIABLES,
Bremen Univ. (Germany, F.R.).
G-P. Zauke.
Water Research, Vol 16, No 6, p 785-792, June, 1982. 4 Tab, 59 Ref.

Descriptors: Rivers, *Cadmium, Crustaceans, *Gammarus, *Seasonal variations, Temperature effects, Metals, Fate of pollutants, Werra River, Weser River, *Federal Republic of Germany.

This study represents an attempt to realize the approach of a field study using multivariate statistical methods. The relationship between seasonal variation of cadmium in natural populations of Gammarus tigrinus and selected environmental variables was investigated. Results of a correlation analysis indicated that the observed variation of cadmium in G. tigrinus was related to the cadmium concentration of the river Weser and to the water temperature. However, partial correlation coefficient anlaysis showed water temperature to be the most important factor. The relationship between cadmium levels in G. tigrinus and in the water of the Weser turned out to be an imaginary correlation. Highest cadmium levels were noted in populations of G. tigrinus collected in winter, lowest in populations collected in summer. These findings are discussed in view of the hypothesis of an increased elimination of cadmium via exuvia in the summer population. (Baker-FRC)
W82-06659

AREAL EXTENT OF A PLUME OF MINERALIZED WATER FROM A FLOWING ARTESIAN WELL IN DADE COUNTY, FLORIDA,

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Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199852, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-20, 1982. 20 p, 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Water quality, *Groundwater, *Path of pollutants, *Saline water intrusion, Aquifers, Specific conductivity, Chlorides, Water pollution, *Florida, Dade county, Everglades, Floridan aquifer, Biscayne aquifer.

A flowing artesian well that taps the Floridan aquifer at Chekika Hammock State Park is contaminating the overlying Biscayne aquifer with saline water. The plume of mineralized water extends approximately 7 miles southeast of the well and ranges in width from 1 to 2 miles. The areal extent of contamination in the primary plume is approximately 12 square miles. The principal ions contaminating the Biscayne aquifer are chloride, sodium, and sulfate. (USGS)
W82-06680

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. R. Seitz, and M. L. Jones.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-102, October 1981. 56 p, 9 Fig, 10 Tab, 18 Ref.

Descriptors: *Water quality, *Streamflow, *Path of pollutants, *Data collections, Outlet channels, Cross sections, Discharge measurement, Velocity, Water analysis, Nutrients, Bacteria, Trace metals, *Idaho, Spokane River, Coeur d'Alene Lake, Post Falls Dam.

The Spokane River leaves the northern end of Coeur d'Alene Lake, flows westward past the cities of Coeur d'Alene and Post Falls, Idaho, through the Spokane Valley, and joins the Columbia River west of Spokane, Wash. Cross-sectional properties and water-quality characteristics were determined for flows of 6,100 to 8,440 cubic feet per second during June 8 to 12; 750 to 1,760 cubic feet per second during August 24 to 27; and 1,790 to 1,630 cubic feet per second during November 3 to 7, 1980. Cross-sectional areas measured ranged from 4,620 square feet to 17,000 square feet. Flow velocities ranged from 2.00 feet per second during June to less than 0.10 foot per second during August and November. Water quality in the reach was generally good. A small increase of total ammonia nitrogen occurred downstream of the Coeur d'Alene sewage-treatment plant. (USGS)
W82-06681

EVALUATION OF A PREDICTIVE GROUND-WATER SOLUTE-TRANSPORT MODEL AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
B. D. Lewis, and F. J. Goldstein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204066, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-25, March 1982. 71 p, 26 Fig, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Groundwater, *Radioactive waste disposal, *Path of pollutants, Computer models, Solute transport, Chemical wastes, Chlorides, Tritium, Geohydrology, Observation wells, Monitoring, Groundwater movement, Chemical analysis, *Idaho, Idaho National Engineering Laboratory, Snake River Plain aquifer.

Aqueous chemical and radioactive wastes discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 have affected the quality of the ground water in the underlying Snake River Plain aquifer. The aqueous wastes have created large and laterally dispersed concentration plumes within the aquifer. The waste plumes with the largest areal distribution are those of chloride, tritium, and with high specific conductance values. The data from eight wells drilled near the southern INEL boundary during the summer of 1980 were used to evaluate the accuracy of a predictive modeling study completed in 1973, and to simulate 1980 positions of chloride and tritium plumes. Data interpretation from the drilling program indicates that the hydrogeologic characteristics of the subsurface rocks have marked effects on the regional ground-water flow regimen and, therefore, the movement of aqueous wastes. As expected, the waste plumes projected by the computer model for 1980, extended somewhat further downgradient than indicated by well data due to conservative worst-case assumptions in the model input and inacurate approximations of subsequent waste discharge and aquifer recharge conditions. (USGS)
W82-06689

HYDROLOGIC AND CHEMICAL EVALUATION OF THE GROUND-WATER RESOURCES OF NORTHWEST ELKHART COUNTY, INDIANA,
Geological survey, Indianapolis, IN. Water Resources Div.
T. E. Imbrigiotta, and A. Martin, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197369, Price codes A08 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 81-53, October 1981. 140 p, 49 Fig, 14 Tab, 42 Ref.

Descriptors: *Groundwater, *Groundwater availability, *Water quality, *Water pollution effects, Landfills, Leachate, Observation wells, Aquifer characteristics, Flow system, Glacial drift, Organic compounds, Plumes, Groundwater movement, Water level fluctuation, Drawdown, Computer models, Chemical analysis, *Indiana, Elkhart County.

A study of the aquifer system underlying northwest Elkhart County, Indiana, has defined the general flow and quality of the area's ground water. The regional ground-water flow is toward the St. Joseph River. A ground-water-flow model was used to simulate pumpings of 7.5-, 10-, and 20-million gallons per day at the airport. The model-generated water-level maps indicated that only for the 20-million-gallons-per-day simulated pumping could a small part of the total flow into the pumping center come from the Himco landfill area. The general ground-water quality was characterized by slightly basic pH (7-8), average hardness greater than 150 milligrams per liter as calcium carbonate, and a calcium bicarbonate water type. Eight volatile organic compounds were detected in samples from an industrial park area in east Elkhart. Concentrations of dissolved solids, bicarbonate, bromide, chloride, sulfate, ammonia, calcium, magnesium, manganese, potassium, sodium, and dissolved organic in the leachate were at least five times their background concentration. The leachate plume was primarily in the shallow aquifer and extended between 3,100 and 5,600 feet downgradient from the Himco landfill. (USGS)
W82-06691

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,
Missouri Univ., Kansas City. Dept. of Biology.
D. H. Stern, and M. S. Stern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256769, Price codes: A06 in paper copy, A01 microfiche. Report, May 1982, Water Resources Research Center, Columbia, MO. 106 p, 5 fig, 1 Tab, 42 Ref, 2 Append. OWRT A-128-MO(1), 14-34-0001-1127.

Descriptors: *Water pollution sources, *Heavy metals, *Pollution load, *Sediments, *Bottom sampling, Environmental protection, Nonpoint pollution sources, Population exposure, Sublethal effects, Cobalt, Cadmium, Chromium, Copper, Iron, Rural areas, Streams, Urban areas, Sampling, Surface runoff, Rivers, Trace metals, *Missouri, Kansas City.

The concentration and distribution of sediment heavy metals were determined in the major stream of each of 3 adjacent watersheds in the Kansas City (Missouri) metropolitan area. The metals were examined in bottom sediments of each stream during 4 seasons under various precipitation/flow conditions. The effects of human activities/urbanization on sediment metal levels/distribution in the streams was assessed. Kansas City area sediments contained higher levels of many metals than sediments of other watercourses. Downstream Blue River stations indicated urban industrial pollution (e.g., runoff from highly active roads, rail lines, bankside steel fabricators, automobile salvage yards). Blue River concentrations of a number of metals (cadmium, chromium, copper, iron, lead, manganese, nickel, zinc) downstream, exceeded those at residential/park/ pastoral upstream locations and those in the other two (suburban and rural) streams studied. Only cobalt was higher in rural areas than urban areas. Stations near the confluence of each stream with the Missouri River had metal concentrations exceeding literature data for many of the metals analyzed. Iron levels appeared slightly higher in January than at other times of the year; other metals showed no seasonable variation. Water quality data at the sediment sampling stations are also reported. (Zielinski-MAXIMA)
W82-06702

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,
Massachusetts Univ., Boston. Dept. of Biology.
M. P. Shiaris, and G. S. Sayler.
Environmental Science and Technology, Vol 16, No 6, p 367-369, June 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Polychlorinated biphenyls, *Biotransformation, *Microbial degradation, Reservoirs, Water sampling, Oxidation, Chlorine, Biodegradation, Path of pollutants, Water pollution, Biological oxidation, Mineralization, *Tennessee, Center Hill Reservoir.

The ability of natural mixed microbial populations in lake water to oxidize PCBs was investigated. A preliminary examination of PCB removal (by hexane extraction) in samples of water from Center Hill Reservoir, Tennessee, that had been exposed to PCBs indicated a significant reaction of PCBs with microbial populations but did not assess the fate of PCBs. Incubation of water samples from the reservoir with a PCB mixture containing 54% chlorine by weight resulted in no oxidation. This indicates that for complex mixtures of PCB, mineralization was insignificant relative to adsorption, volatilization, and cellular accumulation, which occur kinetically at a much faster rate. However, incubation of samples with 2-chlorobenzoic acid and chlorobenzoylformic acid (chlorophenylglyoxylic acid). The results indicate that chlorobenzoic acids can be expected to accumulate during degradation of the lesser chlorinated biphenyls in the environment and support the hypothesis that aquatic ecosystems have detectable potential for PCB biodegradation. (Gish-FRC)
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
J. I. Parker, and J. G. Ferrante.
Environmental Science and Technology, Vol 16, No 6, p 363-367, June 1982. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Offshore platforms, *Natural gas, *Discharge measurement, *Organic compounds, *Inorganic compounds, Plumes, Pollutant identification, Sodium, Magnesium, Sulfate, Chloride, Hydrocarbons, Volatile hydrocarbons, Methane, Ethane, Nephelometry, Lakes, *Lake Erie,

Canada, Environmental Effects, Water pollution sources.

Turbid discharge plumes from a Canadian offshore natural gas drilling rig in Lake Erie were mapped by continuous-flow nephelometry, and the concentrations of certain organic and inorganic constituents in the plumes were measured. Buoyant surface plumes A and B were tracked and mapped on 5.30.1979, while plume C was monitored on 5.31.1979. Plumes A and B drifted eastward about 600-1,500 m before dispersing to background total suspended solids (TSS) levels (< or = 0.4 mg/L). They achieved maximum widths of about 200 m and included areas of approximately 10-25 ha. TSS concentrations ranged from 0.4 to 1.2 mg/L. Plume C covered about 3.5 ha and drifted only about 320 m before TSS concentrations declined to background level. However, TSS levels were higher in plume C, reaching a maximum of 5.3 mg/L about 25 m downcurrent of rig discharge. The survey of plume chemistry showed that sodium, sulfate, and chloride concentrations were not elevated in plume C at distance > 25 m and that these constituents dispersed rapidly after discharge. At a distance of 25 m from the rig, magnesium concentrations were significantly higher than at other locations within the plume and at reference stations, but rapidly declined to ambient lakewater levels throughout the remainder of the plume, suggesting that the area of high concentration was < 1 ha. Volatile hydrocarbon analysis showed minor increases of methane and ethane (less than a factor of 2 above ambient levels) in plume C, and these declined rapidly at distances > 100 m from the rig. Absolute levels were < 25 micrograms/L. The potential for adverse environmental effects resulting from these discharges is considered minimal. (Gish-FRC)
W82-06720

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,
Military Engineering Services, Hyderabad (India).
For primary bibliographic entry see Field 5C.
W82-06723

PHYSICOCHEMICAL PROPERTIES AS USEFUL TOOLS FOR PREDICTING THE ENVIRONMENTAL FATE OF ORGANIC CHEMICALS,
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
W. Klopffer, G. Rippen, and R. Frische.
Ecotoxicology and Environmental Safety, Vol 6, No 3, p 294-301, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Organic compounds, *Environmental effects, Physicochemical properties, Persistence, Sinks, Vapor pressure, Volatility, Solubility, Adsorption, Path of pollutants, *Fate of pollutants, Chemicals, Organic wastes,.

The physical and chemical properties of a chemical largely determine the distribution of that chemical between the environmental media of air, water and soil/sediment. Relatively inexpensive measurements can be used to predict roughly the distribution of these chemicals. In particular such estimates are very important in the assessment of new chemicals. In the case of new chemicals, nothing is known about the behavior of the substance in the natural environment. Models still remain to be developed for calculating the distribution on the basis of physicochemical data for different environmental conditions or, alternatively, by using globally averaged data. It is shown that, except in the case of highly persistent chemicals, distribution can only be considered in conjunction with (biotic and abiotic) degradation processes. According to the knowledge at present, the key properties with regard to the environmental fate included vapor pressure, water solubility, absorption and desorption behavior, partition coefficient (octanol/water), volatility from aqueous solution, and hydrolysis and photochemical reactivity in the air, water, and when absorbed at surfaces (aerosol, soil, organic matter). An interesting consequence of the close interrelation of persistence and mobility is that if a chemical has a strong tendency to enter a specific medium or sector of the environment such as water and there is no sink for it in this sector but only in another sector, such as in the air, then the transfer velocity between these sectors will determine the persistence. Thus in certain cases mobility may control persistence. (Baker-FRC)
W82-06727

PRELIMINARY STUDY OF THESSALONIKI BAY FOR CONTAMINATION BY MERCURY AND LEAD,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
G. S. Vasilikiotis, N. A. Voulouvoutis, D. G. Themelis, and M. C. Sofoniou.
Chemosphere, Vol 11, No 5, p 479-496, May, 1982. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Heavy metals, *Wastewater disposal, Thessaloniki Bay, *Greece, *Mercury, *Lead, Industrial wastes, Municipal sewage, Water pollution sources, Path of pollutants.

Thermaikos Gulf is estimated to receive more than 80,000 cubic meters per day of domestic sewage and some 25,000 cubic meters per day of industrial wastewater. Mercury and lead concentrations were examined in the Gulf as possible indicators of pollution levels. The northern part of the Gulf was selected for study due to its geological configuration and the fact that the municipal sewage and factory wastes enter this particular basin directly. The amounts of mercury and lead in the sea water and sediment samples taken from this basin were significantly increased in regions close to the outfalls of sewage and wastewater. Contamination peaks were seasonally correlated with various maintenance programs carried out in the industrial plants. At these times the industrial wastewaters even more heavily contaminated with the heavy metals. The high metal content of the seawater at the start of the winter season could also be due to the rainfall washing out to sea the street dust which is rich in heavy metal dust particles. At this same time the increased wind and wave activity in the water body would be stirring up metal particles which had settled to the bottom sediment layer. Analysis showed that the heavy metal concentration in the sediment layer was related to the sediment content of organic residues. (Baker-FRC)
W82-06728

RATES OF MINERALIZATION OF TRACE CONCENTRATIONS OF AROMATIC COMPOUNDS IN LAKE WATER AND SEWAGE SAMPLES,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. E. Rubin, R. V. Subba-Rao, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1133-1138, May, 1982. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Lakes, *Mineralization, Wastewater, Metabolism, Microorganisms, Organic compounds, Aromatic compounds, Phenols, Microbiological studies, Kinetics Eutrophication, Oligotrophic lakes, *New York.

This investigation was designed to determine the kinetics of mineralization of several compounds in samples of freshwater and sewage. For this purpose a method was developed to test the rates at chemical concentrations lower than those studied heretofore. The rates of mineralization of phenol, benzoate, benzylamine, p-nitrophenol, and di(2-ethylhexyl) phthalate added to lake water at concentrations ranging from a few picograms to nanograms per milliliter were directly proportional to chemical concentration. At levels of less than 1 pg of phenol or p-nitrophenol per ml the rates were still linear, but they were below the predicted value at 1.53 pg of 2,4-dichlorophenoxyacetate per ml. Mineralization of 2,4-dichlorophenoxyacetate was not detected in samples of lake water containing 200 ng of the chemical per ml. The slope of a plot of the rate of phenol mineralization in samples of three lakes as a function of its initial concentration was lower at levels of 1 to 100 micrograms/ml than at higher concentrations. In lake water and sewage supplemented with less than 60 ng ogf C14-labeled benzoate or phenylacetate per ml, 95 to 99% of the raioactivity disappeared from solution, indicating that the microflora assimilated little or none of the carbon. The extent of mineralization of some compounds in samples of two lakes and sewage was least in the water with the lowest nutrient levels. No mineralization of 2,4-dichlorophenoxyacetate and the phthalate ester was observed in samples from an oligotrophic lake. These data suggest that mineralization of some chemicals at concentrations of less that 1 microgram per ml is the result of activities of organisms that metabolize the chemicals at low concentrations but assimilate little or none of the substrate carbon. (Baker-FRC)
W82-06738

SURVIVAL OF ESCHERICHIA COLI IN LAKE BOTTOM SEDIMENT,
Wisconsin Univ. La Crosse, River Studies Center.
P. LaLiberte, and D. J. Grimes.
Applied and Environmental Microbiology, Vol 43, No 3, p 623-628, March, 1982. 2 Fig, 2 Tab, 39 Ref.

Descriptors: *Lake sediments, *Bacteria, Lakes, *Bottom sediment, Sediment, Sedimentation, Escherichia Coli, Fecal Coliforms, Coliforms, Lake Onalaska, Mississippi River, Water quality, Culturing techniques, Dialysis cultures, *Minnesota.

The in situ survival of the fecal coliform Escherichia coli in lake bottom sediment was investigated using dialysis culture techniques. The study sites were located in Lake Onalaska, an impoundment of lock and dam no. 7 on the Mississippi River at Dresback, Minnesota. The lake surface area was 2,146 hectares, with an average depth of 155 cm. The pool receives water from the Mississippi and Black Rivers and has water chemistry characteristics similar to those of the Mississippi. Lake Onalaska does not stratify, has an average annual alkalinity of 125 mg/liter, supports extensive growths of rooted, aquatic vegetation, has a high nutrient trapping efficiency, and is quickly progressing toward hypereutrophic conditions. Daily most probable number determinations indicated that E. Coli populations in unsterile inoculated sediment fluctuated between 530 and 2200 bacteria per g of silty clay and between 3000 and 14000 bacteria per g of sand. Autoclaved silty clay sediment inoculated with 1,000,000 bacteria per g showed increases to 220,000,000 bacteria per g in 3 days. During the same period, autoclaved sand sediment inoculated with 120,000 cells per g increased to 54,000,000 bacteria per g. By day 5, populations in both cultures had decreased by 1 log. The ability of E. coli to survive for several days in aquatic sediment in situ suggests that fecal coliforms in water may not always indicate recent fecal contamination of that water, but rather resuspension of viable sediment-bound bacteria. (Baker-FRC)
W82-06741

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,
Cawthron Inst., Nelson (New Zealand).
For primary bibliographic entry see Field 5A.
W82-06755

KINETICS AND EXTENT OF MINERALIZATION OF ORGANIC CHEMICALS AT TRACE LEVELS IN FRESHWATER AND SEWAGE,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
R. V. Subba-Rao, H. E. Rubin, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1139-1150, May, 1982. 5 Fig, 8 Tab, 15 Ref.

Descriptors: *Mineralization, *Organic compounds, *Kinetics, Metabolism, Microorganisms, Lakes, Eutrophication, Oligotrophic lakes, Natural waters, Wastewater.

The mineralization of low levels of several C14-labeled organic compounds was studied in natural waters. Attempts were also made to enhance microbial activity by supplementing the waters with

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readily available carbon and energy sources. Lake waters with different natural nutrient levels wre used to assess the effect of nutrient status on the extent of mineralization. A sensitive and rapid method to detect mineralization was developed. From 93 to 98% of benzoate, benzylamine, aniline, phenol and 2,4-dichlorophenoxyacetate at one or more concentrations below 300 ng/ml was mineralized in samples of lake waters and sewage, indicating little or no incorporation of carbon into microbial cells. Assimilation of C-14 by the cells mineralizing benzylamine in lake water was not detected. Mineralization in lake waters was linear with time for aniline at 5.7 pg to 500 ng/ml, benzylamine at 310 ng/ml, phenol at 102 fig to 10 mg/ml, 2,4-dichlorophenoxyacetate at 1.5 pg/ml, and di(2-ethylhexyl)phthalate at 21 pg to 200 ng/ml, but it was exponential at several p-nitrophenol concentrations. The rate of mineralization of 50 and 500 ng of aniline per ml and 200 pg and 2.0 ng of the phthalate per ml increased with time in lake waters. The phthalate and 2,4-dichlorophenoxyacetate were mineralized in samples from a eutrophic but not an oligotrophic lake. Results obtained on addition of benzoate-utilizing bacteria, glucose or phenol to the lake water showed that the kinetics of mineralization, the capacity of the aquatic community to assimilate carbon from the substrate or the extent of assimilation, and the sensitivity of the mineralizating populations to organic compounds are different at trace levels than at higher concentrations of organic compounds. (Baker-FRC)
W82-06756

MODEL ECOSYSTEM FOR ENVIRONMENTAL TRANSPORT OF XENOBIOTICS,
Jyvaskyla Univ. (Finland). Dept. of Cell Biology.
M. T. Virtanen, M. Kihlstrom, A. Roos, and H. Kainulainen.
Archives of Environmental Contamination and Toxicology, Vol 11, No 4, p 419-424, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Xenobiotics, *Environmental effects, *Pesticides, Soil contamination, Model studies, Ecosystems, DDT, Ecology, Soil properties, Organic compounds, Agricultural chemicals, Soil solution, Leaching, *Path of pollutants, Laboratory studies.

A compartmentalized model is reported to study the transport of agricultural chemicals in soil drainage. In this model drainage from the soil is channeled into the aquatic system together with groundwater, providing a slow, fluctuating water flow. C-14 labeled DDT was used as a reference toxicant. The variability of the model exosystem was evaluated, and some recommendations are given for future work. The terrestrial part was built of washed gravel and soil in a container. The aquatic part was an aquarium provided with an overflow pipe. A layer of gravel was scattered on the bottom of the aquarium. The behavior of DDT in this system may be considered to mimic its behavior in a soil/water system under natural conditions. DDT became tightly bound to the soil, which acted as a reservoir. A compound with a high partition coefficient (highly lipophilic) such as DDT has a strong tendency to accumulate in aquatic biota, but its transfer to the aquatic environment is limited by its adsorptive properties, and its availability to aquatic biota is accordingly reduced. (Baker-FRC)
W82-06760

DIFFERENTIAL PHOSPHORUS ASSIMILATION IN ATTACHED VS. UNATTACHED MICROORGANISMS,
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
H. W. Paerl, and S. M. Merkel.
Archiv fur Hydrobiologie, Vol 93, No 2, p 125-134, January, 1982. 3 Tab, 21 Ref.

Descriptors: *Microorganisms, *Phosphorus, *Absorption, *Path of pollutants, Estuaries, Estuarine environment, Lakes, Eutrophication, Metabolism, Nutrients, Bacteria, Natural waters, Suspended sediments, Oligotrophic lakes, Trophic levels, Particulate matter, *Waste assimilative capacity.

One aspect of particle-related phosphorus uptake was investigated - differential uptake activities of attached vs. free floating bacteria in natural aquatic ecosystems. This is significant in determining the relative importance of phosphorus uptake and cycling on particle-bound vs. free-floating microorganisms. Microautoradiography was used to study the uptake of phosphorus. A variety of aquatic ecosystems was studied, exhibiting a range of trophic states. Lake Tahoe, California, a deep ultra-oligotrophic lake, was studied, as was Heart Lake, Ontario, which is a small, shallow, eutrophic lake, and Lake Taupo on the North Island of New Zealand, which is a deep oligo-mesotrophic lake. Samples were also taken from the Newport River Estuary in North Carolina. In all systems studied particle-rich waters showed higher uptake rates per unit volume than particle-poor waters. Bacteria associated with particles were responsible for elevated uptake rates and exhibited higher relative uptake rates per cell than free-living bacteria. Differences in cellular phosphorus uptake between attached and unattached bacteria were greatest under oligotrophic and least under eutrophic conditions. The significance of these findings with regard to particles as nutrient-concentrating microenvironments in natural waters is discussed. (Baker-FRC)
W82-06762

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,
Institute fuer Meeresforschung (Germany, D.R.).
S. Wellershaus.
Archiv fur Hydrobiologie, Vol 92, No 2, p 161-198, September, 1981. 21 Fig, 1 Tab, 66 Ref.

Descriptors: *Estuarine environment, *Turbidity, Estuaries, Marine environment, Coastal waters, Mud flats, Sedimentation, *Suspended sediments, Tidal waves, Tidal marshes, Tidal effects, Water currents, Weser Estuary, *West Germany.

The accumulation of particles with low settling velocities along a mud shoal is shown to be due to a combination of transport of particles from other areas, formation of particles in the salt wedge area, and trapping of particles due to hydrographic mechanisms. The tidal Weser Estuary was the study site; it experienced a turbidity maximum and mud shoal near the tip of the salt wedge. Non-tidal estuaries may have a mud shoal, but since alteration and strength of tidal currents are lacking, a strong turbidity maximum may also be absent. In all undisturbed tidal coastal plain estuaries the same mechanisms may lead to effects similar to those in the Weser. However, the channel will be much shallower, and in the turbidity maximum the seston concentration may be less. It is noted that fractionation of particles into subclasses may also lead to fraction of pollutants that may be constituents of particles in one of these fractions. It is expected that dredging will initiate chemical and biological reactions that would not occur in an undisturbed estuary. Thus some types of suction dredging select the heavier particles such as fine sand and larger pieces, while the lighter aggregates escape out of the hold together with the overflowing water and remain in the turbidity maximum. Thus natural processes are hindered by maintenance dredging. The main cause for the muddy character of the sediment is the non-tidal estuarine circulation, which results in collection, amassment and settling of particles with low settling velocities in the salt wedge area. Tidal oscillation, causing alternating sedimentation and resuspension of the particles, is the main source of visual turbidity in an estuary not disturbed by man. (Baker-FRC)
W82-06766

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert.
Water Research , Vol 16, No 6, p 775-784, June, 1982. 3 Fig, 3 Tab, 37 Ref.

Descriptors: *Heavy metals, *Public health, Mercury, Lead, Copper, Chromium, Cadmium, Chao Phraya River, *Thailand, Estuaries, Seasonal variations, bottom sediments, Fish.

Heavy metal pollution was examined in the Chao Phraya River estuary. Seasonal variations were noted, but the patterns were not the same for different heavy metals of different sampling stations along the river. The relatively high concentrations of heavy metal in the river mouth vicinity indicated a possible accumulation of heavy metals which may have been due to the movement of pollutants from upstream, sources from wastewater discharges from the Bangkok Metropolis and industrial estates south of Bangkok, and the physical characteristics of the estuary and tidal movements that tended to stagnate water in this area. Twenty-seven species of fish of various sizes were also studied. The results indicate that the Chao Phraya River estuary is being polluted by heavy metals, and that the accumulation of Cd, Cu, Cr, and Pb in water in the vicinity of the river mouth is significant. If pollution were to continue, long term accumulation of heavy metals in sediments and fish in the river mouth could occur because the water pH in this area is between 7 and 8 and because the bio-accumulation and bio-magnification of fish reared in heavy metal polluted water have been reported elsewhere. The probable ingestion of mercury and lead in fish from this region is a matter for concern. (Baker-FRC)
W82-06774

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W82-06787

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and A. L. Yarechewski.
Journal of Emvironmental Science and Health, Part B, Vol 17, No 4, p 363-380, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Agricultural chemicals, *Degradation, *Fate of pollutants, Laboratory studies, Degradation products, *Terbutryn, *Herbicides, Water pollution, Organic compounds, Environmental effects, *Oxidation-reduction potential, *Sediments, Rivers, Ponds, Bottom sediments.

The major degradation pathways of terbutryn in sediment and water were studied under laboratory conditions which simulated the use of this herbicide in aquatic environments. Degradation of terbutryn in static culture flask incubations proceeded slowly, with half-lives of about 380 days in both river and pond sediments. The disappearance of terbutryn in water was more rapid , with half-lives of 240 days and 180 days in water above pond and river sediments, respectively. Redox potentials in these static systems following 200 days of incubation averaged +384 mv in water and +364 mv in sediment, indicating that aerobic conditions prevailed. Degradation proceeded much more slowly in autoclaved sediments and water, suggesting that biological activity was essential in order for rapid degradation to occur. The major degradation product from static incubations was hydroxyterbutryn (HT). Also eluting on the chromatogram was a peak corresponding to N-deethyl hydroxy terbutryn (DEHT) as a minor product. A second major product was terbutryn sulfoxide (TS). A comparison of these studies with field studies on the fate of terbutryn in small ponds indicated that the laboratory studies closely simulated the persistence of the herbicide. Breakdown of terbutryn in laboratory sediment-water systems appears to be inversely related to redox potential, as the degradation rate was slowed dramatically at low potential. Measurement of redox potential in sediments from treated water bodies in field experiments may be a useful means of predicting terbutryn persistence under field conditions. (Baker-FRC)
W82-06790

COAL AND COAL MINE DRAINAGE,

Tennessee Valley Authority, Chattanooga.
H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 717-723, June, 1982. 2 Tab, 67 Ref.

Descriptors: *Literature review, *Coal mining, *Mine drainage, *Mine wastes, *Reviews, Water pollution sources, Fate of pollutants, Strip mines, Coal mines, Acid mine drainage, Water pollution effects, Regulation, Water pollution control, Wastewater treatment, Leachates, Slurries, Sulfur, Sulfates, Wastewater treatment.

The role of coal and mine drainage in water pollution is the subject of a literature review. A table presents the subjects and authors of selected papers from the 1981 symposium on surface mining hydrology, sedimentology, and reclamation. Studies on formation of coal mine drainage included identifying potential acid-producing strata, the good correlation between carbonate-sulfur ratio and effluent quality, and pyrite oxidation. The effects of coal mining on hydrology and stream water quality are reported from various locations in the U.S. Acid mine drainage and groundwater deterioration were reported in many cases. In the western U.S., total dissolved solids is the major problem associated with coal mining. Methods for treating mine drainage include chemical neutralization, settling ponds, and limed plots of land. Reclamation techniques involve acid-tolerant macrophytes in streams and lakes and use of municipal sludge in revegetation. The impact of coal cleaning was evaluated in 17 projects sponsored by the EPA. Generally, physical coal cleaning is more economical than other sulfur-removal strategies such as flue gas desulfurization and use of low-sulfur coal. Problems with coal transportation are mentioned: formation of carcinogens in chlorinated coal-slurry pipeline water and corrosion on combustion of coal slurried with salt water. Some work has been done on the subject of coal pile drainage. (Cassar-FRC)
W82-06802

GROUND WATER,
SMC-Martin, King of Prussia, PA.
G. H. Emrich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 784-786, June, 1982. 29 Ref.

Descriptors: *Literature reviews, *Groundwater, *Reviews, Sampling, Sample preparation, Water sampling, Model studies, Monitoring, Water quality, Organic compounds, Mathematical models, Groundwater pollution, Path of pollutants.

Recent research in the area of groundwater pollution is cited in this review of the current literature. The main emphasis during 1981 has been the need for determining the occurrences, extent, and sampling of groundwater pollution in response to the implementation of federal and state programs. A manual of groundwater sampling procedures was prepared. A grab sampler for obtaining highly volatile organic compounds from unsaturated zones was presented. Several researchers indicated a need for improving the quality of information obtained from groundwater sampling programs. Implementation of the underground injection control phase of the State Safe Drinking Water Act of 1974 began in earnest. A digital model of a buried channel aquifer contaminated by hydrocarbons was used to evaluate three management alternatives. Laboratory-determined chemical parameter values were used in simulation of transport of ion-exchanging solutes governed by local chemical equilibrium. A kinematics mathematical model was used to develop flow and arrival time plots of groundwater contaminants. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, recognizing the need for a systematic approach to setting priorities for the investigation and cleanup of hazardous waste sites. Two roles that surface geophysical methods can play in groundwater monitoring were defined - direct measurement of contaminated water and the determination of boundary conditions. A method was presented for calculating apparent resistivities for application in delineating plumes of contaminated ground water. Surface resistivity was used in a monitoring program. A combination of four surface geophysical methods was used to investigate groundwater pollution and locate buried drums at a chemical dump. (Baker-FRC)
W82-06807

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto.
Water Research, Vol 16, No 6, p 1065-1070, June, 1982. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Phosphorus, *Kinetics, Path of pollutants, Measuring instruments, Chemical reactions, Particulate matter, Water pollution control, Suspended solids, Water analysis.

The design, testing and application of an experimental apparatus which has proved useful to the kinetic description of two aspects of phosphorus dynamics in aquatic systems are described. The apparatus is referred to as a Dual Culture Diffusion Apparatus (DCDA), and it is designed so that two microbial populations can interact in a syntrophic manner through substances dissolved in the liquid phase. The apparatus permits the extraction of process kinetic data for several types of particulate-water interactions. The apparatus is useful and flexible for characterizing and quantifying certain biochemical processes in aquatic systems. It may also be used for adsorption-desorption process studies as a function of time without disturbing the vessel housing the process of interest. Other applications include microbial mediated recycle or transformation of organics bound to particles, biological partitioning and microbial degradation or release of the partitioned compounds, and many types of microbial species interactions. (Baker-FRC)
W82-06829

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, J. Schreiner, and G. D. Hopkins.
Water Research, Vol 16, No 6, p 1025-1035, June, 1982. 13 Fig, 8 Tab, 13 Ref.

Descriptors: *Groundwater recharge, *Water quality, Aquifers, Recharge, *Artificial recharge, Injection, Replenishment, Water supply development, Water supply, *California, Palo Alto Baylands, *Organic compounds, Biodegradation.

A field study was performed wherein reclaimed water was injected directly into an aquifer in the Palo Alto Baylands, near San Francisco Bay. The injection rate was 6 liters/second of reclaimed municipal wastewater. The concentrations of organic constituents were affected by processes such as adsorption and biodegradation during recharge even though the recharged water had received advanced treatment including granular activated carbon. The influence of adsorption was observed as retardation of the transport of trace organic compounds, which are retained to varying degrees in the aquifer. The effects of biodegradation are evidenced by decreasing concentrations of total organic carbon, chemical oxygen demand, and dissolved oxygen as the water spread out from the injection point. In general the concentrations of TOC and COD responded rapidly to fluctuations in input concentration, indicating that the bulk of organic constituents in the reclaimed water did not engage in sorptive interaction with the aquifer material. Halogenated organic compounds showed no evidence of retardation or retention during aquifer passage. Organic pollutants remaining after water reclamation treatment pose a potential health threat if the reclaimed water is to be directed to potable reuse. Groundwater recharge by direct injection affords protection by affording opportunities for adsorption and degradation and by smoothing concentration fluctuations. (Baker-FRC)
W82-06831

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,
State Univ. of New York, Syracuse. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W82-06836

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,
Plainville Water Co., CT.
For primary bibliographic entry see Field 5G.
W82-06842

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W82-06860

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06861

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2F.
W82-06864

A CASE STUDY OF A CHEMICAL SOIL: POLYCHLORINATED BIPHENYLS (PCBS) 1. HISTORY, DISTRIBUTION, AND SURFACE TRANSLOCATION,
National Research Council of Canada, Ottawa (Ontario).
J. R. Roberts, J. A. Cherry, and F. W. Schwartz.
Water Resources Research, Vol 18, No 3, p 525-534, June, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Translocation, Water pollution sources, Organic chemicals, Industrial wastes, Leaching, Permeability, Soil porosity, *Saskatchewan,.

This paper presents background information about the spill, explains techniques used in sample collection, preparation and analysis, and describes the distribution and surface movement of PCBs at the spill site, a transformer manufacturing plant in Regina, Saskatcheqan, Canada. Between 6,800 and 21,000 liters of transformer oil containing Aroclor 1254 and chlorobenzenes were spilled at an underground pipe break. Large quatities of PCBs were found to have migrated both vertically and horizontally at the site. PCBs at concentrations of about 1000 mg/kg moved downward through granular fill and 9 meters of fractured Regina clay. Contaminant migration along the interface of the clay and the upper unit of permeable granular fill probably accounted for the extensive lateral movement. It was argued that because of the low organic content of the geological units at the site and the hydrophobicity of chlorinated organics like PCBs, contaminants at many locations exist in three phases: a dissolved aqueous phase, an adsorbed phase, and an oily liquid phase. Movement of the oily liquid seems to be the most likely explanation for the migration of large quantities of PCBs downward through fractures in the clay and laterally through the granular fill. (Baker-FRC)
W82-06865

A CASE STUDY OF A CHEMICAL SPILL: POLYCHLORINATED BIPHENYLS (PCBS). 2. HYDROGEOLOGICAL CONDITIONS AND CONTAMINANT MIGRATION,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, J. A. Cherry, and J. R. Roberts.
Water Resources Research, Vol 18, No 3, p 535-545, June, 1982. 8 Fig, 2 Tab, 21 Ref.

LIBRARY U. OF I., URBANA-CHAMPAIGN

Descriptors: *Path of pollutants, *Groundwater pollution, *Polychlorinated biphenyls, Water pollution sources, Organic chemicals, Leaching, Permeability, Soil porosity, Aquifers, Drinking water, Wells, Well water, Geology.

The hydrogeology of a spill site in Regina, Canada is described as it relates to the observed patterns of PCB contamination. Six major hydrostratigraphic units were identified from detailed test drilling and sampling. From the surface downward there are a thin surface fill, Regina clay, Condie silt, till zone, interglacial silt, and Regina aquifer system. This later unit is a significant source of potable groundwater. At present the nearest wells are hundreds of meters from the spill site. The permanent water table is situated below the Condie silt in sandy glacial till. An active perched groundwater system was developed within the thin fill layer beneath the floor of the plant. The extensive lateral flow of groundwater in this zone has contributed significantly to the spreading of PCBs at this site. The PCBs have also moved downward through fractures in the Regina clay and upper part of the Condie silt. It can be expected that capillary forces will halt the downward movement as fractures narrow or stop. However, the possible existence of fractures connecting the contaminated zone to the Regina aquifer system or the potential for transport as a dissolved phase in the groundwaters may permit PCBs to migrate downward to the aquifer or to flow laterally off-site. The most significant hazard is the potential for contamination of future water supply wells that may be placed near the site or aquifer contamination that could result if future drilling provides pathways for contaminants through poorly sealed wells or test holes. (Baker-FRC)
W82-06866

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,
Minnesota Pollution Control Agency, Roseville.
S. Y. T. Leung, and J. J. Richard.
Water Resources Bulletin, Vol 18, No 3, p 485-493, June, 1982. 2 Fig, 4 Tab, 54 Ref.

Descriptors: *Pesticide residues, *Pesticide, *Reservoirs, Accumulation, Lakes, Insecticides, *Agricultural chemicals, Atrazine, Alachlor, Cyanazine, Dieldrin, DDE, Des Moines River, Rivers, *Iowa, Suspended sediments.

From September 1977 through November 1978 single 4-liter water samples were collected weekly or every 2 weeks beneath the surface and at mid-depth or near the bottom to estimate amounts of selected pesticides entering and leaving Saylorville Reservoir, a new partly filled impoundment on the Des Moines River in Iowa. Atrazine, alachlor, andd cyanazine, which have low affinity for suspended sediment and are highly soluble in water, were found only in the dissolved fraction of Des Moines River water. Atrazine levels in water ranged from 0 to 1,356 ng/1, with an overall mean of 223 ng/1. Alachlor concentrations ranged from 0 to 1,450 ng/1, with an overall mean of 89 ng/1. Cyanazine concentrations ranged from 0 to 660 ng/1 and followed a seasonal trend similar to alachlor, with higher levels occurring in June and July. Dieldrin concentrations in water ranged from 1 to 33 ng/1, and that compound was found in both dissolved and suspended fractions of river water. Dissolved p,p'-DDE levels were mostly less than 1 ng/liter, with suspended concentrations ranging from 0 to 66 ng/1 and averaging 7 ng/liter, with suspended concentrations ranging from 0 to 66 ng/1 and averaging 7 ng/liter. The estimated deposition in the reservoir from September 1977 to October 1978 was 281 kg atrazine, 251 kg alachlor, 26 kg cyanazine, 16 kg dieldrin, and 20 kg p,p'-DDE. (Baker-FRC)
W82-06871

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,
Geological Survey, Orlando, FL.
R. A. Miller, and H. C. Mattraw, Jr.
Water Resources Bulletin, Vol 18, No 3, p 513-519, June 1982. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Storm water, *Runoff, Water quality, Regression analysis, Land use, Basins, Fort Lauderdale, *Florida, Nitrogen, Phosphorus, Zinc, Oxygen demand, Mathematical studies.

Storm water runoff studies were made of three small basins in the Fort Lauderdale area of Florida to estimate annual loads through the use of linear regressions for a variety of water quality constituents, to define the range of constituent concentrations and loads typical of storm water in south Florida, to develop methods for transferring the information concerning concentrations and loads to other similar areas, and to meet information requirements of the various county and state agencies in Florida. Due to the large amount of data collected, a data management system was developed to store, analyze, and output data. Most of the storm water leaving the basins originated as rainfall on the hydraulically effective impervious area (HEIA). A large part of each of the constituent loads also originated on the hydraulically effective impervious area. Additional regression analysis showed that multiplicative models are superior to additive models for total residue and total lead. For total nitrogen, total phosphorus, total carbon, andd total zinc the additive models were superior to the multiplicative models. Total nitrogen and phosphorus HEIA yields were highest in the single family residential basin, whereas chemical oxygen demand and lead yields were highest in the commercial basin. In the highway drainage basin, total N and total P inputs exceeded outputs. Total zinc input exceeded output in both the highway and commercial areas. (Baker-FRC)
W82-06877

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, and L. J. Albright.
Applied and Environmental Microbiology, Vol 43, No 6, p 1227-1237, June, 1982. 2 Fig, 8 Tab, 25 Ref.

Descriptors: *Bacteria, *Heterotrophic bacteria, *Particulate matter, Amino acids, Glucose, *British Columbia, Salinity, Fate of pollutants.

The contributions of attached and free-floating bacteria to the bacterial numbers and heterotrophic uptake in 44 aquatic environments (marine, estuarine, lake, river, and creek) were studied in the southwest corner of British Columbia. Cluster analysis placed the 44 sites into five distinct environmental types based on three factors (salinity, heterotrophic uptake, and particulate load) which accounted for 53.6% of the variation. The five groups were: A, marine with low turnover times and low particulate load; B, marine, with high turnover times and no particulate load; C, fresh water with high turnover times; D, fresh water with a range of turnover times and heavy particulate loads. The order of clusters with increasing attached-fraction uptake of amino acids was A < B < E < C < D and for glucose, A < B < C < E < D. Clusters D and E had much higher bacterial counts than A, B, and C. Heavy particulate loads were associated with an increased percentage uptake of amino acids and glucose from the attached bacteria. In oligotrophic fresh water, uptake response was substrate specific. Amino acid uptake was more associated with the attached fraction; glucose uptake, with the free-floating fraction. (Cassar-FRC)
W82-06887

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,
Veterans Administration Medical Center, Pittsburgh, PA.
A. Brown, V. L. Yu, M. H. Magnussen, R. M. Vickers, and G. M. Garrity.
Applied and Environmental Microbiology, Vol 43, No 3, p 725-726, March, 1982. 15 Ref.

Descriptors: *Aerosols, *Human disease, *Bacteria, Microorganisms, Air pollution, Fallout, Sediment, Pneumonia, Legionella, *Tatlockia, Public health, Water pollution sources, Epidemiology, *Pittsburgh pneumonia agent.

The isolation of Tatlockia (Legionella) micdadei, the Pittsburgh pneumonia agent (PPA), from sediment obtained from a hospital shower is reported. Sediment was scraped with a sterile Dacron swab from the shower heads and mixing valves of 25 showers on 10 wards at the Pittsburgh Veterans Administration Medical Center. All recovered sediment was suspended in buffered yeast extract broth. Cultures were prepared and incubated aerobically and observed daily. Whereas several of the samples contained L. pneumophila, one contained a gram-negative rod which grew on the supplemented yeast extract agars but not on sheep blood agar. On the dye-containing buffered charcoal-yeast extract agar it grew as a blue-grey, nonfluorescing colony, typical of T. micdadei. It is suggested that the isolation of this organism from shower heads may be clinically significant because it provides further evidence that a water associated reservoir exists within the hospital. In addition, since an aerosol is produced by showering, this is a plausible source for the transmission of an organism producing pneumonia. (Baker-FRC)
W82-06891

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS).
Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.
P. K. Kearns, and R. J. Vetter.
Hydrobiologia, Vol 88, No 3, p 277-280, May, 1982. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Radioisotopes, *Accumulation, *Aquatic life, Fate of pollutants, *Manganese radioisotopes, Fish, Algae, Invertebrates, Radioactive wastes, Daphnia, *Chlorella, *Perch, Bioaccululation, Nuclear powerplants.

The concentration factor and biological half-life of Mn54 were determined in three members of a food chain. Green algae (Chlorella), Daphnia magna, and yellow perch (Perca flavescens) were exposed for 168 hours to water containing 5 micro Ci, 20 micro Ci, and 5 micro Ci of Mn54, respectively. Mn54 was added as necessary to keep the levels constant throughout the experiment. Concentration factors for algae, Daphnia, and perch were 4230, 17,000 and 11, respectively. The data suggest that these aquatic organisms can concentrate Mn54 rapidly, which could result in significant exposures to man. Nuclear power generation is one source of this radionuclide. (Cassar-FRC)
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,
Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
P.F.M. Verdonschot, M. Smies, and A.B. J. Sepers.
Hydrobiologia, Vol 89, No 1, p 29-38, April, 1982. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Oligochaetes, *Saline water intrusion, Chlorides, *Benthic fauna, Estuarine environment, *Brackish water, *The Netherlands, Scheldt Estuary, Deltas, Aquatic invertebrates, Salinity, Species composition.

Benthic macrofauna were sampled at 37 sites in the Delta region of The Netherlands (Scheldt Estuary) from January to June 1979. Waters in this unstable environment, below sea level and immediately behind the sea walls, have water temperature fluctuations of < 0 to > 20 C from winter to summer and sudden, irregular chlorinity variations up to 20 o/oo chloride at a single station. The distribution of the 23 species of oligochaetes was related to median chlorinity at the sampling station. There were 10 Tubificidae, 11 Naididae, 1 Lumbriculidae, and 1 Lumbricidae. Nais elinguis occurred throughout the chlorinity range. Oligochaetes formed two groups: brackish-marine and brackish-limnetic. The dividing line was about 1.5 o/oo

chloride. The brackish-marine group was resistant to high chlorinities and to wide fluctuations in chlorinity. (Cassar-FRC)
W82-06905

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,
Hong Kong Univ., Dept. of Botany.
L. L. P. Vrijmoed, I. J. Hodgkiss, and L. B. Thrower.
Hydrobiologia, Vol 87, No 2, p 143-160, 1982. 3 Fig, 7 Tab, 62 Ref.

Descriptors: *Coastal waters, Fungi, *Aquatic fungi, *Hong Kong, Salinity, Temperature effects, Acidity, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Nitrogen, Phosphorus, Light penetration, Sediments, Estuaries, Estuarine environment, *Marine fungi, Pearl River Estuary.

The effect of a range of environmental factors on the distribution of lignicolous marine fungi was studied in Hong Kong coastal waters. Five sites were chosen for study of the higher saprobic fungi of the lignicolous marine mycota. The Pearl River Estuary exerts an influence on the coastal waters especially during the wet season, when salinity, nutrient levels and the amount of sediment are affected. Throughout the year the average salinity increases, while the nutrient level and organic load decrease from west to east across the coastal waters. Among the 51 species recorded, 3 species remained unidentified. Of the 48 remaining species, 28 were considered either facultative or oligate marine forms; the remaining 20 species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species included Halosphaeria quadricornuta, Cirrenalia macrocephala, Ceriosporopsis halima, and Trichocladium achrasporum. These species were found at all test sites. Regarding the abundance of species, frequency of occurrence and species composition of this group of more frequent lignicolous marine fungi, it appeared that two major patterns emerged. For mixed-mesohaline waters there was only one dominant fungus and many fortuitous species. For the mixo-polyhaline zones there was one dominant fungus and several important fungi co-existing but with fewer fortuitous species. There was no increase in the number of species nor any appreciable change in the Ascomycotina/Deuteromycotina ratio with increasing salinity. (Baker-FRC)
W82-06908

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBE-ASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).
Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
For primary bibliographic entry see Field 5C.
W82-06913

MICROBIOLOGY: WATER,
Environmental Protection Agency, Cincinnati, OH., Drinking Water Research Division.
E. E. Geldreich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 931-943, June, 1982. 173 Ref.

Descriptors: *Literature reviews, *Bioindicators, *Microbiological studies, *Reviews, Bacteria, Public health, Lakes, Impoundments, *Indicators, Water pollution effects, Environmental effects, Ecosystems, Rivers, Water pollution sources, Coastal waters, Corrosion, Water quality, Swimming pools, Drinking water, Antibiotic resistance.

Recent research in the area of water microbiological studies is cited in this review of the literature. Research into the use of microbial indicators of pollution included the development of multiple test kits for speciation of many waterborne aerobic and anaerobic organisms, changes in the heterotrophic bacterial density and subgroups as an indicator of qualitative changes in physicochemical characteristics of the Yodo River in Japan, the isolation of Aeromonas hydrophila from frogs and tadpoles, the potential human health hazard from toxigenic bacteria in water, the relationship between isolation of mycobacteria and classical microbiological and chemical indicators of water quality in swimming pools, bacteria in public water supplies, and the health risk of human exposure to wastewater. Microbial ecology of water was investigated in the light of solar radiation and naturally occurring microbial predators as important forces in the natural self-purification of polluted surface waters, short term exposure of E. coli to oligotrophic natural waters, the use of fecal indicators, biocumulation of copper and lead in aquatic life forms, the corrosion potential of four tropical Desulfovibrio desulfuricans isolates, microbial bioconcentration of organic pollutants from aquatic systems, and the microbial degradation of petroleum hydrocarbon. Much research was also conducted on the microbiology of river systems in coastal areas and on the microbiology of natural lakes and impoundments. (Baker-FRC)
W82-06924

MICROBIOLOGY: DETECTION, OCCURRENCE AND REMOVAL OF VIRUSES,
Louisiana State Univ., Baton Rouge, Dept. of Civil Engineering.
D. Roy, and M. E. Tittlebaum.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 984-986, June, 1982. 31 Ref.

Descriptors: *Literature reviews, *Viruses, *Reviews, *Microbiological studies, Water pollution control, *Pollutant identification, Path of pollutants, Bioindicators, Enteroviruses, Bacteriophage, Coliphages, Land disposal, Wastewater treatment, Shellfish.

Recent research in the area of detection, occurrence and removal of viruses is cited in this literature review. Detection methodology advanced in the areas of recovery of viruses from large volumes of water and wastewater using membrane filtration with microporous filters, in the efficiency of recovery of rotavirus from domestic wastewater by an adsorption elution technique followed by centrifugation, in the concentration of viruses from water samples using soluble ultrafilters composed of gelified alginate, in methods for concentrating bacteriophages from water and wastewater, in the recovery of viruses by elution from sludge flocs, and in the isolation of viruses using various concentration techniques. Survival of viruses was examined in systems following the transport of enteroviruses through sil at a wastewater irrigation site, in samples of wastewater, primary effluent and secondary effluent in Australia, in water to determine its effect on survival and transport of viruses into receiving waters and potentially back to humans, and in regard to the isolation of ribonucleic acid caliphages from raw wastewater samples in Japan. Research on the removal of viruses by treatment processes includes studies of the efficiency of waste stabilization ponds. Different factors were examined in the removal of viruses in soil-sludge systems, and the fate of sludge-associated viruses was investigated during sludge lagoon detention and after land application. Viruses were studied in shellfish, and indicators for viruses were sought. (Baker-FRC)
W82-06927

SOLID WASTES AND WATER QUALITY,
Envirodyne Engineers, Knoxville, TN.
G. R. Brower, and R. Ramkrishnadas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 749-754, June, 1982. 54 Ref.

Descriptors: *Literature reviews, *Solid wastes, *Reviews, Water quality, Industrial wastes, Municipal wastes, Waste disposal, Hazardous wastes, Radioactive wastes, Monitoring, Groundwater pollution, Environmental effects, Chemical analysis, Water analysis, Public health.

Current research in the field of solid wastes and water quality is cited in this literature review. The EPA groundwater protection strategy is defined. Environmental impact studies conducted on the Niagara River pollution, Salmonellosis occurrences in Scotland, volcanic ash leachate from Mt. St. Helens, and effects of waste disposal sites on groundwater quality are cited. Disposal of residues from solid waste treatment on ash ponds, by land application or through sanitary landfills was considered. The extent of contamination in groundwater of Missouri was investigated. Monitoring techniques used at waste disposal sites were described. Additional studies concerned with design, collection and attenuation included a study of the polluation threat to the water supply of Frederiksund, Denmark, the effect of differences of travel times in unsaturated zones between low and high leaching in groundwater table levels, factors affecting variations in phosphorus in irrigation return water, concentrations and losses of dissolved phosphorus from a tile drained silt loam before and after manure applications, and potential health problems associated with the presence of persistent organic chemicals in wastewater. In the area of characterization and treatment of solid wastes the chemical and mineralogical characterization of coal solid wastes was investigated along with the concentration of arsenic in coal ash, the chemical characterization of leachates from unretorted mined oil shales, and a comparison of analysis of leachate samples by different laboratories. Hazardous wastes were examined as to the behavior of such wastes in landfills, analyses of water and sediment samples near waste disposal sites, monitoring methods, regulations regarding hazardous waste disposal, and the denitrification of radioactive waste. (Baker-FRC)
W82-06929

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,
Michigan University, Ann Arbor, Great Lakes Research Division.
For primary bibliographic entry see Field 5C.
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,
Wisconsin University, Platteville.
For primary bibliographic entry see Field 5C.
W82-06938

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5C.
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
J. F. Lekan, and T. A. Coney.
Journal of Great Lakes Research, Vol 8, No 1, p 144-152, 1982. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, Mapping, *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, Nitrogen, Model studies, Mathematical models, Areal distribution, Path of pollutants, *Cladophora.

An intensive field and laboratory program was designed to gain a more complete understanding of the ecology of the alga Cladophora glomerata in Lake Huron. Key elements are a knowledge of the spatial distribution and seasonal growth characteristics of the organism. Remote sensing data were

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obtained for a 2.8 km section of Lake Huron shoreline at Harbor Beach, Michigan. The data were collected using an eleven channel modular multispectral scanner mounted in an aircraft on a clear, calm day over the lake. Cladophora was determined by a conventional maximum likelihood statistical supervised classification technique employing three of the scanner bands. An intensive field survey of the study site indicated that the computer classified imagery is representative of the Cladophora distrbution at Harbor Beach. Classification accuracy was not determined, as the site was not mapped by ground surveys. The percent of areal coverage of model cells by Cladophora ranged from 0 to 93%. Calculations based on these percentages indicate that the alga occupies an area of 38,704 square meters at the study site. Overlapping flight lines resulted in duplicate measurements of many model cells. The reproducibility of results for these areas was good when suitable well defined Cladophora training sites are common to adjacent data sets. The reproducibility decreases in the absence of this condition. (Baker-FRC)
W82-06973

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,
McGill Univ., Montreal,(Quebec). Dept. of Biology.
R. Carignan, and J. Kalff.
Limnology and Oceanography, Vol 27, No 3, p 419-427, May, 1982. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Macrophytes, *Phosphorus, *Nutrients, Microorganisms, Microenvironment, Path of pollutants, Epiphytes, Hydrophytes, Aquatic plants, Microbiological studies, *Quebec, Lake Memphremagog, *Myriophyllum.

The use of fully labeled macrophytes in quantifying the importance of macrophytes to the phosphorus nutrition of their epiphytes, the release rates of phosphorus by Myriophyllum spicatum L., and the availability of the released phosphorous are discussed. The study was performed in Lake Memphremagog in a protected bay classified as mesotrophic with mean aestival total, soluble and soluble reactive phosphorus concentrations of 10.5, 2.2, and 0.5 micrograms/liter, respectively. The epiphytes of nine species of fully labeled macrophytes were collected between July and September 1977. The epiphytes derived only 3.4-9.0% of their P from the supporting macrophyte, indicating that previously suggested macrophyte-epiphyte nutrient interactions are of relatively minor importance. Although high diurnal P release rates were observed for the Myriophyllum-epiphyte complex, Myriophyllum accounted for only 9.9% of the total P released. The Myriophyllum-derived P was, however, released in a highly available soluble form. During the growing season, Myriophyllum thus appears to be principally important as a physical support for an active microbial community rather than as a P source to its epiphyton and surrounding waters. (Baker-FRC)
W82-06977

INVESTIGATION OF THE DISTRIBUTION OF WARM WATER DISCHARGE INTO SHALLOW WATER BODIES,
All Union Designing, Surveying, and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev.
Water Resources, Vol 8, No 4, p 378-388, July/August, 1981. 5 Fig, 16 Ref. Translated from Vodnye Resursy, No 4, p 77-90, July/August, 1981.

Descriptors: *Reservoirs, *Powerplants, *Thermal pollution, Fate of pollutants, Shallow water, Cooling ponds, Heated water, Nuclear powerplants, Water temperature, Temperature, Unsteady flow, Model studies, Numerical analysis, Air-water interfaces, Hydrothermal studies, Ponds, Reservoirs, Mathematical equations, *USSR.

The distribution of water temperature in unstratified water bodies impacted by warm water discharge was investigated by numerical modeling and by using hydrothermal models with a given function characterizing heat exchange at the water-air interface. Ordinary cooling ponds and water bodies at powerplants were examined. These are characterized by markedly unsteady flow. The equations were applied to the planned three-reservoir system in South Ukraine: Aleksandrovsk Reservoir, which will receive water from a nuclear power station through the Tashlyk Reservoir and ambient-temperature water from the Konstantinovka Reservoir hydroelectric station. Calculations showed that under the proposed operating regime, temperatures over the 28.1 C limit would prevail over 1/3 of the Aleksandrovsk Reservoir and a small part of the Konstantinovka. It was predicted that the entire cooling pond of the Smolensk nuclear power station would be 31-47 C during the hottest month of the year. (Cassar-FRC)
W82-06981

5C. Effects Of Pollution

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
D. Toetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243361, Price codes: A04 in paper copy, A01 in microfiche. Report, January 1982. 40 p, 8 Fig, 8 Tab, 25 Ref. OWRT A-091-OKLA(1), 14-34-0001-0138.

Descriptors: *Nitrogen, *Phosphorus, *Reservoirs, *Algal control, *Nitrogen fixing bacteria, Algae, Nutrient requirements, Lakes, Rivers, Reservoir operation, Water supply, Nitrogen compounds, Nitrogen fixation, Nitrogen cycle, Nitrates, Ammonia, *Oklahoma, *Lake Hefner.

Research was carried out to determine if low nitrogen (N) to phosphorus (P) ratios in Lake Hefner loadings were related to the development of populations of N-fixing algae in the lake. The hypothesis was also tested that, if N/P ratios in the lake loadings were 5 or less, N-fixing algae would contribute significant N amounts to the total lake budget; thus, the lake would compensate for low N/P ratios of the loadings. This lake is a terminal offset water supply reservoir (1044 ha area, 1.96 years residence time, 8.86 m mean depth), and is entrophic with a history of taste and odor problems in its finished water. All lake loading N/P ratios wrere 7.2, and N-fixing blue-green algae developed populations but did not fix substantial amounts of N (only 0.5% of total input). The concentrations of nitrate and ammonia in the euphotic zone probably suppressed N-fixation, hence, the lake responded as predicted. Annual loadings for P and N were 10 and 65 mg/sq m, respectively. Regulated flows from the North Canadian River (the major source of water for the lake) accounted for about 83% of the N and 93% of the P entering the lake annually. Precipitation contributed 15% and 6% of the N and P, respectively. River nutrient input to the lake represents the best control point for lake nutrient input to control lake water taste and odor. (Zielinski-MAXIMA)
W82-05912

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-05919

CARRYING CAPACITY FOR THE ILLINOIS RIVER,
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 6G.
W82-05927

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,
Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243577, Price codes: A06 in paper copy, A01 in microfiche. Report No 712437, January, 1982. 115 p, 10 Fig, 18 Tab, 207 Ref, 5 Append. OWRT B-079-OHIO(1).

Descriptors: *Cadmium, *Bacterial analysis, *Aquatic soils, *Heavy metals, *Toxicity, Sediments, Microorganisms, Water quality, Hazardous materials, Spectral analysis, Chemical analysis, Water analysis, Water quality control, Microenvironment, Environmental effects, Microbiological studies.

Research was conducted to examine how cadmium (Cd) may effect bacteria in laboratory microcosms and natural sediment populations. The study results demonstrated that the effects of Cd on natural sediment bacterial populations and on laboratory microcosm populations can be related; acclimation of bacteria to the toxic effects of Cd may occur in both systems. Bacteria of diverse biotypes could overcome Cd toxic effects after Cd exposure. However, bacteria in a laboratory water column were found to be more affected by Cd exposure than sediment bacteria. Absorption of Cd by bacteria and sediment showed higher absorption by bacteria than the sediment on a dry weight basis. The results provide an improved understanding of how Cd may influence bacteria in the environment and in other systems (e.g., waste treatment facilities), and of how bacteria may compete with particulate matter for available Cd in the water column and interstitial water. Bacterial uptake of Cd could result in the mobilization of Cd into the food chain where Cd accumulation might represent a potential human health hazard. Analyses of Cd were carried out by a reported atomic absorptoin spectrophotometry method. (Zielinski-MAXIMA)
W82-05934

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,
Beckman Instruments, Inc., Carlsbad, CA.
For primary bibliographic entry see Field 5A.
W82-05951

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,
Eco-Research Ltd., Inc., Point-Claire (Quebec).
For primary bibliographic entry see Field 5D.
W82-05955

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,
Genoa Univ. (Italy). Fisiologia Generale.
A. Viarengo, M. Pertica, G. Mancinelli, S. Palmero, and G. Zanicchi.
Marine Environmental Research, Vol 6, No 3, p 235-243, 1982. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Heavy metals, *Monitoring, *Water pollution effects, *Mussels, Bioindicators, Pollutant identification, Water quality, Chemical analysis, Coastal waters, Italy, Metabolism, Proteins, Stress, Cadmium, Mercury, Zinc, Copper.

Whether or not mussels collected from a heavy metal polluted area exhibited a stress syndrome which can be detected through variations in several biological parameters was studied. Species of Mytilus galloprovincialis Lam. were collected from La Spezia (polluted) and Portofino (unpolluted) from November 20 to December 5, 1979.The study demonstrated that the values of the rates of amino acid uptake and protein synthesis in the gills and digestive glands of the animals collected from the polluted area are significantly lower than those of the mussels sampled from the baseline area. The synthesis of RNA in nuclei obtained from the digestive gland of the mussels collected from the population of La Spezia was significantly reduced. Since temperature, salinity and pH values were similar in both areas studied and all animals were in

the same stage of the reproductive cycle, it is possible to speculate that the decrease in the values of the biological parameters examined reveals a stress syndrome which could be related to the increased metal concentration in the tissues of the mussels from the polluted area. The results allow the conclusion that mussels may be used as a self-integrating index of pollution in monitoring programs and indicate that the accumulation of pollutants in mussel tissues may result in a stress syndrome, as revealed by variations in several biological parameters. (Baker-FRC)
W82-05983

THE ACUTE TOXICITY OF MOTOR FUELS TO BRACKISH WATER ORGANISMS,
National Environment Protection Board, Studsvik (Sweden). Brackish Water Toxicology Lab.
M. Tarkpea, and O. Svanberg.
Marine Pollution Bulletin, Vol 13, No 4, p 125-127, April, 1982. 1 Tab, 3 Ref.

Descriptors: *Brackish water, *Fuel, *Toxicity, Seawater, Organisms, Aquatic organisms, Water pollution effects, Invertebrates, Methanol, Fish, Methyl tertiary butyl ether, Baltic Sea.

This study was performed to determine whether the acute toxicities to representative species from the Baltic Sea of blended fuels containing methanol or methyl tertiary butyl ether differed from those of base fuel, gasoline or low leaded gasoline. Alburnus alburnus (bleak) and the harpacticoid Nitocra spinipes were chosen as representative species. Low leaded gasoline, base fuel and blend fuel M15 15% methanol were rather highly acute toxic to the bleak. Of the three additives methanol, isobutanol and MTBE, the first was practically non-toxic, while isobutanol and MTBE were slightly toxic. Sublethal effects such as disturbed balance, surface swimming and overturning were noted in the bleak after only a couple of minutes of exposure to MTBE. Several individuals recovered before the experiment was ended. The 96 hour median lethal dose values for Nitocra spinipes varied between about 150 and 250 mg/liter for the actual motor fuels. For the bleak, the toxicity of the three additives was less than that of the actual motor fuels. The results of the study demonstrate that the acute toxicity of base fuel to aquatic organisms was not increased by the addition of 15% methanol of 5% MTBE. The risk of increasing the toxicity by the use of solvents with the potency of dissolving more of the hydrocarbons into the water phase was not verified in the experiment. (Baker-FRC)
W82-05985

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,
World Health Organization Schistosomiasis Control Project, Accra (Ghana).
D. Scott, K. Senker, and E. C. England.
Bulletin of the World Health Organization, Vol 60, No 1, p 89-100, 1982, 1 Fig, 9 Tab, 11 Ref.

Descriptors: *Epidemiology, Diseases, *Parasites, Schistosomiasis, Lakes, *Volta Lake, *Ghana, *Human diseases, Water pollution effects.

The prevalence of urinary schistosomiasis rose dramatically around Volta Lake within a year of full impoundment in 1968. During 1973-75 the incidence of the disease was investigated in 26 communities along 80 km of lake shore. In the total population 72.0% and 73.7% were infected in 1973 and 1974, respectively. Age, sex, and ethnic affiliation (indigenous Krobo farmers and immigrant Ewe fishermen) influenced the prevalence and intensity (egg output) of infection. In general, prevalence (over 90%) and egg output reached a peak in the 10-14 year age group and declined with increasing age. Males had higher egg outputs than females beginning in the 5-9 year age group and higher prevalence beginning in the 15-24 year age group. Egg output in the Krobos increased and decreased more rapidly with age than among the Ewe. Persons living in the Pawmpawm branch of the lake had lower prevalence (65%) and intensity of infection than those living among the Afram branch (80-84% prevalence). Transmission of the disease was greater from January to April during the period of high lake level and the early part of the drawdown. The number of infected Bulinus truncatus rohlfsi, the snail intermediate host, and the abundance of Ceratophyllum demersum, an aquatic weed closely associated with the snail, were highest in areas of highest human transmission and in seasons of highest human transmission. Human water contact was also correlated with intensity of infection. Children, males, Krobo children, and Ewe adults, more frequently in contact with water, had a correspondingly higher intensity and prevalence of the disease. (Cassar-FRC)
W82-05988

MALIGNANT MELANOMA AND DRINKING WATER CONTAMINATION,
Miami Univ., FL.
T. E. Aldrich, and A. J. Peoples.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 519-523, May, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Water pollution effects, *Human diseases, *Drinking water, *Organic compounds, *Mathematical studies, Water treatment, Chloroform, Chlorination, Municipal water, Model studies, Water analysis, *Epidemiology, Public health, Halogens.

When a major medical facility of Brevard County, Florida, reported potential clustering of malignant melanoma in 1975-1977, an investigation was carried out to see whether cases of this cancer could be significantly correlated with the trihalomethan (THM) levels in the municipal water supplies. Cluster analyses of data involved a cell occupancy method and an interval approach based upon the Knox model, involving definitions of spatial and temporal thresholds. Use of these techniques gave values extremely different from those calculated from the Third National Cancer Survey data. However, when the community experience was distributed according to population density, no clustering was observed. Results of the interval approach also showed no clustering. A dramatic north-south gradient of THM levels was generated from water analysis data. These data also indicate that increased THM formation in south Brevard County results from normal treatment of water. Blood sample analyses supported the north-south pattern of exposure, with high serum chloroform levels in areas where high THM levels existed in water. (Geiger-FRC)
W82-05989

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,
New York State Department of Health, Albany Div. of Labs. and Research.
T. C. Lederman, and G. Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 388-394, March, 1982. 8 Fig, 22 Ref.

Descriptors: *Algae, *Inhibition, Growth rate, *Hexachlorobiphenyl, *Polychlorinated biphenyls, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, *Phytoplankton, Insecticides, Water pollution effects, Toxicity, Chlorophyll a, Nutrients, Phosphates, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

The effects of 2,4,5,2',4',5'-hexachlorobiphenyl (HCB) at low levels (0.,2-1.2 micrograms per liter) on the growth of algae were investigated in continuous culture under nutrient sufficient conditions and phosphate limited conditions. Under nutrient sufficient conditions only Fragilaria crotonensis growth rate was inhibited by cellular HCB concentrations as low as 0.8 micrograms per g dry weight. There was a dose-response relationship between cellular HCB and growth rate. Microcystis sp. and Ankistrodesmus falcatus growth rates were not inhibited by 3.6 and 11.5 micrograms per g dry weight or less, respectively, under nutrient sufficient conditions. Under P limiting conditions F. crotonensis, but not Microcystis and A. falcatus, showed growth rate inhibition. The pattern observed in F. crotonensis growth curves under P-limitation was a marked increase in cell numbers for 2 days followed by a decrease to levels lower than the control; this was not seen under nutrient-sufficient conditions. In both nutrient sufficient and nutrient limiting conditions in F. crotonensis cultures the cellular chlorophyll a concentration decreased with accumulation of HCB, and the C13 assimilation rate per unit chlorophyll a increased. Cellular P concentration in the P-limited cells also decreased with HCB accumulation. These results suggested that contamination with polychlorinated biphenyls can alter community composition in an aquatic environment. (Cassar-FRC)
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris, and R. A. Vollenweider.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 4, p 618-626, April, 1982. 1 Fig, 2 Tab, 62 Ref.

Descriptors: *Lakes, *Eutrophication, *Lake Erie, Great Lakes, Plankton, Phytoplankton, Limnology, Phosphorus, Seasonal variations, *Paleolimnology.

A reinterpretation is made of existing reviews of the changing assemblages of phytoplankton in Lake Erie in the light of new data on the history of phosphorus loadings to the lake, new information on the history of anoxia, and in terms of new data on the diatom remains in a core from the central basin of the lake. The picture that evolves from this re-evaluation suggests that Lake Erie had undergone initial eutrophication as early as 1850, although the main evolution toward a eutrophic system occurred during this century. Those persons concerned with water quality management should be aware that, for a given lake, the relationships between parameters such as total phosphorus, phytoplankton biomass, and the species of the assemblage are modifiable by processes operating on a scale of years, and that management schemes based on only a few years' data may need to be revised as new data become available. It is considered from this review that the initial disturbance to the metabolism of Lake Erie was the most important one in its eutrophis history. Events in the Lake Erie Basin over the last 50 to 60 years must be viewed in the light of these long term fluctuations and must be interpreted with great care. (Baker-FRC)
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,
Canada Center for Inland Waters, Burlington (Ontario).
P. T. S. Wong, Y. K. Chau, and D. Patel.
Chemosphere, Vol 11, No 4, p 367-376, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Algae, *Metals, *Toxicity, Water pollution effects, Heavy metals, Primary productivity, Productivity, Scenedesmus, Aminoisobutyric acid, *Great Lakes, Water quality standards, Phytoplankton, Nitrogenase activity, Synergistic effects.

A mixture of 10 metals at the Great Lakes Water Quality Objective individual levels reduced the primary productivity of cultured algae and a natural phytoplankton community from Lake Ontario. The metal levels (in micrograms metal per liter) in the full strength mixture were: As, 50; Cd, 0.2; Cr, 50; Cu, 5; Fe, 300; Pb, 25; Hg, 0.2; Ni, 25; Se, 10; and zn, 30. The full strength mixture reduced primary productivity to 31%, 45%, 37%, 45%, and 59% of the originaal levels in Scenedesmus, Chlorella. Anabaena, Navicula, and the natural community, respectively. Metal solutions of 0.1 and 0.5 of the original strength reduced productivity to a lesser degree. In Anabaena flos-aquae, an indicator of nitrogenase activity as reduced to 74% (not preincubated with metals) and 59% (pre-incu-

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bated for 24 hours) by the full strength mixture and to 37% and 21%, respectively, by a 10-fold strength solution. The metal mixture also caused a reduction in reproduction and in transport of alpha-aminoisobutyric acid by Ankistrodesmus falcatus. (Cassar-FRC)
W82-05996

PERIPHERAL EFFECTS OF CADMIUM ON THE BLOOD AND HEAD KIDNEY IN THE BROWN BULLHEAD (ICTALURUS NEBULOSUS),
Bergen Community Coll., Paramus, NJ. Div. of Natural Sciences and Mathematics.
J. S. Garofano, and H. I. Hirshfield.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 552-556, May, 1982. 3 Tab, 8 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Catfish, *Monitoring, *Bioindicators, Kidneys, Blood, Heavy metals, Metals, Fish, Bioassay, Indicators, Pollutant identification, Fish toxins, Fish physiology, Absorption, Uptake.

Since the chemical leakage of cadium (Cd)-containing refuse can lead to the contamination of drinking water supplies, there is need for an accurate biological monitor for the presence of Cd in water. Studies were undertaken on brown bullhead catfish (Ictalurus nebulosus) to determine the amount and rate of Cd uptake via atomic absorption measurements and to determine whether acute Cd exposure (61 ppm) alters blood and head kidney cytology. Results showed that the peripheral blood cell differential counts and head kidney hemopoietic cell lines of indigenous fish species feeding in the area of a Cd-containing dump site provide the best immediate monitor for water quality. Chemical analyses demonstrate that the head kidney may be an initial target organ for Cd toxicity. The uptake, storage and clearance of Cd from the peripheral blood and head kidney are described for time periods of immediately after and 2 hr after exposure. (Geiger-FRC)
W82-06003

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,
Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
For primary bibliographic entry see Field 5A.
W82-06021

BIOASSY TRIALS WITH TWENTY THREE PESTICIDES TO A FRESH WATER TELEOST, SACCOBRANCHUS FOSSILIS,
D.A.V. Coll., Muzaffarnagar (India). Dept. of Zoology.
S. R. Verma, S. K. Bansal, A. K. Gupta, N. Pal, and A. K. Tyagi.
Water Research, Vol 16, No 5, p 525-529, May, 1982. 4 Tab, 15 Ref.

Descriptors: *Pesticides, *Fish, *Toxicity, Insecticides, *Bioassy, Carbamate pesticides, Halogenated pesticides, Organic pesticides, Organophosphorus pesticides, Water pollution effects, Saccobranchus fossils.

Toxicities of 23 pesticides were determined in static tests using the fresh water teleost, Saccobranchus fossilis. The acute toxic ranges and LC50 values for 24, 48, 72, and 96 hours and the relative potency with respect to abate, the least toxic pesticide, were listed for all pesticides. Active toxic ranges (mg per liter) were: thiotox, 0.0060-0.0085; thiodan, 0.0105-0.0132; heptachlor, 0.080-.118; chlordane, 0.32-0.72; aldrin, 0.42-0.85; lindane, 5.00-7.49; BHC, 2.00-3.99; phosalon, 0.083-0.88; quinalphos, 1.50-3.00; diazion, 1.00-3.99; dimehtoate, 4.50-5.90; dichlorvos, 6.00-10.00; Malatox, 7.99-14.00; thiometon, 750-13.96; fenitrothion, 10.00- 17.99; metasystox, 13.84-24.60; malathion, 15.00-20.00; leptophos, 20.00-29.00; dipterex, 29.0037.92; formothion, 140.00160-.70; abate, 200.00-240.20;carbofuran, 0.50-0.80; and carbaryl, 15.07-24.77. The relative order of toxicity was organochlorines > organophosphorus compounds > carbamates. Safe concentrations were listed for all 23 chemicals. These ranged from 4.9584 mg per liter for abate to 0.00014 mg per liter for thiotox. (Cassar-FRC)
W82-06031

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06032

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water Research, Vol 16, No 5, p 503-515, May, 1982. 8 Fig, 2 Tab, 32 Ref.

Descriptors: *Eutrophication, *Model studies, *Phosphorus, Nutrients, Water quality management, Lakes, Reservoirs, Limnology, Pollution load, Algae, Reviews, Nitrogen, Water pollution effects, Chlorophyll, Turbidity, Organization for Economic Cooperation and Development.

The Organization for Economic Cooperation and Development (OECD) undertook at 5-year study to quantitatively define the relationship between the phosphorus load to a water body and its eutrophication-related water quality response. This work resulted in the development of models by Vollenweider and others for use in water quality management programs. Since the completion of the study the OECD models have evaluated the P load-eutrophication response relationships for 40 U.S. water bodies in addition to the 34 previously studied. The remainder of the 200 water bodies investigated worldwide followed the general relationships of the OECD models, showing their wide applicability to different climates, water depths, water body sizes, and natural vs. manmade lakes. The most reliable water quality indicator is chlorophyll concentratin, with Secchi depth concentrations an adequate secondary parameter. A relationship has also been developed between P load and fish yield. At present several model constraints must be considered. The models are applicable only to water bodies in which algal growth is limited by P. They apply only to eutrophication as manifested by planktonic algal growth, not sanitary quality, toxicants, or siltation. Hydraulic residence time must be at least 2 weeks. Only small to moderate inorganic turbidity and color can be present. Other factors affecting model results are water level fluctuations, water withdrawals from the bottom, differences in load-response relationships in arms of a lake, and high suspended solids. (Cassar-FRC)
W82-06034

A METHOD FOR ESTIMATING THE RESPIRATION OF MUD COMMUNITIES IN SHALLOW RUNNING WATER,
Centre Univ. de Savoie, Chambery (France).
D. Fontvieille, and M. Renaud.
Water Research, Vol 16, No 5, 593-599, May, 1982. 5 Fig, 1 Tab, 25 Ref.

Descriptors: *Respiration, *Benthic environment, *Carbon dioxide, Organic matter, Sediments, Bottom sediments, Field tests, River beds, Aquatic life.

A system for determining the respiration of benthic fresh water communities by measuring their carbon dioxide production was evaluated in an organically polluted brook. Carbon dioxide production per unit of water surface decreased as the total carbon concentration of the mud decreased. Errors were greater in samples near the river bank than in those in the middle of the stream. The field apparatus consisted of an incubation chamber held in place by a tripod. Connections to the chamber allowed measurement of CO2 concentration, pH, and other parameters. Total organic matter levels in the experiment were 15,729-34,728 kcal per sq m, and CO2 production, 21.3-63.6 kcal per sq m per joule. (Cassar-FRC)
W82-06036

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06044

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWERPLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Ellis, and P. G. Mann.
Geological Survey Open-File Report 81-1196 (WRI), 1981. 90 p, 11 Fig, 7 Plates, 8 Tab, 14 Ref.

Descriptors: *Effluents, *Thermal powerplants, *Water pollution effects, *Water quality, Induced infiltration, Water storage, Groundwater, Wells, Groundwater movement, Data collections, Boron, Selenium, Fly ash, Chemical analysis, *Colorado, Yampa River basin, Lewis Shale.

Data were collected at the Hayden, Colo., powerplant for about a year during 1978-79 to monitor the effects of effluent and raw-water storage ponds on the local ground water, Sage Creek, and the Yampa River. The concentration of boron in wells downgradient from the effluent ponds indicated that the ponds were leaking, increasing the average boron concentrations in the ground water to a level in excess of the standards for agricultural use of water. Water from seeps, probably the best indicators of downgradient water quality, had average concentrations of boron two times that of the Colorado Department of Health (1977) standard for agricultural use of water. Chemical analyses of water from wells and the discharge weir downgradient from the raw-water storage ponds indicated these ponds are leaking. The effect of this leakage is that the water in wells downgradient from these ponds has a lower specific conductance and a lower boron concentration than the water in wells downgradient from the effluent ponds. The concentration of trace elements in the water from the wells and the discharge weir generally declined during the study, probably because the ground water was recovering from the effects of a plume from the raw-water pond previously used for fly-ash disposal. The effluents from the Hayden powerplant lowered the specific conductance and the iron and manganese concentrations, increased the concentration of boron, and had little or no effect on the selenium concentration in Sage Creek. Sage Creek had no discernible effect on the Yampa River because the volume of water in the Yampa River was so much greater. The effluents from the powerplant also had no discernible effect on the Yampa River. (USGS)
W82-06137

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5A.
W82-06146

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
J. C. Elliott, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243684, Price codes: A07 in paper copy, A01 in microfiche.
Pennsylvania Institute for Research on Land and

Water Resources, University Park, Report, June 1982. 129 p, 18 Fig, 15 Tab, 62 Ref, 4 Append. OWRT A-003-PA(6), 14-34-0001-0140.

Descriptors: *Biomass, *Primary productivity, *Macrophytes, *Computer models, *Streams, *Simulation analysis, Aquatic productivity, Dissolved oxygen, Oxygen, Photosynthesis, Respiration, Benthic environment, Benthos, Aquatic life, Benthic flora, Model studies, Mathematical models, Mathematical studies, Computer programs, Shallow water, Water quality, Eutrophication.

A conceptual model for primary productivity was developed for application to rooted aquatic macrophytes in streams to assist studies of eutrophication and control of water quality in supplementing outputs of dissolved oxygen (DO) models of pollution loads. This model included a first-order differential equation of biomass, with specific rates for photosynthesis, respiration, and death. A model component was developed to describe available light spatially/temporally in the weed bed, as reduced from extraterrestrial solar radiation. A DO model component included terms for photosynthetic production, plant respiration, and a benthal sink due to dead plant matter decay. The latter, a first-order exponential oxygen sink, had not been previously included in DO models. Model parameters and growth rates were determined for a Pennsylvania creek plant population. Data analysis required simulating the plant biomass throughout an annual cycle for each creek reach using stoichiometric relationships between DO productivity and biomass. Simulation was achieved by computer analysis, refined by comparison with selected evaluation criteria for population dynamics and growth rates versus environmental conditions. The model was applied to the study system and tested for sensitivity to variations in basic model parameters. The computer programs for the model are delineated. (Zielinski-MAXIMA)
W82-06153

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Biology.
A. C. Benke, G. E. Willeke, F. K. Parrish, and D. L. Stites.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254905, Price codes: A04 in paper copy, A01 in microfiche. Georgia Environmental Resources Center, Atlanta, Report ERC 07-81, November 1981. 64 p, 22 Fig, 12 Tab, 16 Ref, 2 Append. OWRT A-055-GA(1).

Descriptors: *Urbanization, *Water quality, *Nonpoint pollution sources, *macroinvertebratees, *Water analysis, Aquatic populations, Watersheds, Streams, Aquatic life, Fauna, Aquatic animals, Ecosystems, Water stress, Urban planning, Urban areas, Urban runoff, *Georgia, Atlanta.

The effects of urbanization on 21 stream ecosystems were studied in the Atlanta area in 1-3 sq mile watersheds varying from 3-100% green space, from 0-98% residential-commercial, and with house densities from 0-941 sq miles. The primary index of stream quality was community composition of aquatic macroinvertebrates. The streams were in a single area where physico-chemical conditions and composition of macroinvertebrates should be very similar under natural conditions. While there were widely-varying degrees of urbanization, pollution (as indicated by standard water quality measures) was not at all obvious, and differentiation of stream communities was more subtle than is often encountered in studies of gross pollution. A significant relationship was found between urbanization and number of species/families (but not with species/family diversity, indicating less utility for a diversity index). Hence, identifying macroinvertebrates to the family level is sufficient in assessing differing degrees of stress in streams. Cluster analysis distinguished three major groups of streams: clean, intermediate, and degraded. High residential land use, low levels of green space, and high house densities were associated with degraded streams. (Zielinski-MAXIMA)
W82-06165

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
R. L. Meyer, and N. Woomer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254921, Price codes: A03 in paper copy, A01 in microfiche. Publication No 80, September 1981. 28 p, 1 Fig, 3 Tab, 24 Ref. OWRT A-053-ARK(1). 14-34-0001-0104.

Descriptors: *Benthic flora, Water sampling, *Water analysis, *Algae, *Baseline studies, Benthic environment, Benthos, Aquatic life, Aquatic plants, Aquatic populations, Ecosystems, Biological samples, Water quality, Streams, Algal growth, Algae harvesting, Seasonal variation, Pollutant identification.

Stream biota response to changing water quality or other ecosystem perturbations is an important means of assessing water quality, but the dynamic nature of streams produces significant sampling/measurement problems. However, smaller streams lack a true algal plankton subcommunity and attachment to stones and other stable surfaces at the substrate-water interface represents the major location for algae production. A newly-developed substrate sampler, composed of portland cement, was tested to determine residence time, qualitative similarity between natural/sampler populations, methods for determining primary algae production roles, seasonal succession, and colonization rates. This new approach has been applied, for comparative purposes, to two streams: one influenced by treated municipal sewage; the other, a non-impacted stream. It was determined that the concrete hemispherical samplers are colonized by the same algae in generally the same proportions as those found in adjacent natural rock substrates. These samplers are comparable in size, texture, shape, placement, and position, to the natural rock substrate in this streams study, and are applicable for inter-stream studies. Physical and chemical stream water quality data, biological data, and algae production data are presented. (Zielinski-MAXIMA)
W82-06168

EFFECTS OF APPLE ORCHARD RUNOFF ON THE AQUATIC MACROFAUNA OF A MOUNTAIN STREAM,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management
D. L. Penrose, and D. R. Lenat.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 383-388, 1982. 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Pesticides, *Invertebrates, *Orchards, Water pollution effects, Endrin, Species diversity, Cox Creek, *North Carolina, Macroinvertebrates, Benthic fauna, Apples, Nonpoint pollution sources.

The effects of pesticides in apple orchard runoff were determined at three stations in Cox Creek, North Carolina. Aquatic macroinvertebrates were sampled 10 times from March 1977 to March 1978. The control site, No. 1, was upstream of the orchards: sites 2 and 3 were within and downstream of the orchard area. Stations 2 and 3 showed moderate to severe stress in the macroinvertebrate populations. Numbers per sample were: control, 274; Site 2, 253; and Site 3, 65. Taxa richness indexes were: control, 37.9; Site 2, 30.2; and Site 3, 12.6. Diversity indexes were: control, 3.2; Site 2, 2.9; and Site 3, 2.4. Biotic index values developed by a North Carolina biological monitoring group were: control, 2.3; Site 2, 2.2, and Site 3, 2.7. Periods of low taxa richness and diversity wre associated with spring cover spraying and fall after-harvest sprays. Station 3 was a permanently stressed area, whereas Station 2 goes through repeated stress and recovery. Plecoptera were especially sensitive to apple orchard runoff. Organisms dominant at Station 3 included several stress tolerant species. (Cassar-FRC)
W82-06177

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,
Istituto di Ricerca sulle Acque, Milan (Italy).
G. Chiaudani, and M. Vighi.
Water Research, Vol 16, No 7, p 1161-1166, July, 1982. 5 Fig, 23 Ref.

Descriptors: *Nutrients, *Coastal waters, Eutrophication, Phosphorus, Nitrogen, Phosphatase, *Adriatic Sea, *Algal growth, Pollutant identification.

This study was planned to make use of several approaches to the problem of identifying algal growth-limiting nutrient. The time course of total and free specific phosphatase activities and the changes in soluble reactive phosphorus concentration during algal growth under three different experimental conditions were examined. In cultures grown in medium without phosphorus, phosphatse activity, both total and free dissolved, showed a large increase during the first 7 days, and at the 7th day free phosphatase activity represented 40% of the total activity. In control cultures and in cultures grown in medium without nitrogen, specific phosphatase activities were always detectable, but at very low levels. Phosphorus addition in phosphorus starved cultures caused a drastic drop in the phosphatase activity, reaching levels of control cultures after 3 days. A drop in phosphatase activity of 85% was noted in 24 hr following phosphorus addition. No difference in algal growth rate was noted in cultures spiked with organic or inorganic phosphorus because organic phosphorus quickly became available by means of enzymatic hydrolysis. It was concluded from this study that the most useful indicators of specific nutrient deficiency that can be applied to natural waters are the measurement of phosphatase activity and estimation of the ammonium ion enhancement ratio. Field study results indicated that the phytoplankton populations were phosphorus limited. Nitrogen deficiency was never found during the whole sampling period. (Baker-FRC)
W82-06267

HEAVY METALS IN ANIMALS OF LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
J. Salanki, K. V.-Balogh, and E. Berta.
Water Research, Vol 16, No 7, p 1147-1152, July, 1982. 1 Fig, 8 Tab, 11 Ref.

Descriptors: *Lakes, *Heavy metals, Cadmium, Copper, Manganese, Iron, Zinc, Mercury, Lead, Aquatic animals, Monitoring, Water quality, *Hungary, Lake Balaton.

The concentrations of mercury, cadmium, lead, copper, iron, manganese, and zinc were investigated in mid-living larvae, in zooplankton, and in various organs of bivalves and fish and in the water of Lake Balaton, situated in the western part of Hungary. This lake is the largest shallow lake in Europe, with a surface area of 600 square kilometers and a water content of about 1.8 cubic km. The highest mercury levels were in Chironomidae larvae. Comparatively high concentrations were found in crustacean plankton, in the gills of the mussels and in the kidneys of the fish. Cadmium concentration was highest in the gills of the mussel. Copper concentrations were high in the liver of Abramis brams L. and in the crustacean plankton. The lead concentration was highest the gills of Anodonta. Zinc values were highest in the gills of mussels, highest iron concentrations occurred in Chironomidae larvae, and manganese was extremely variable. The concentration factors (tissue levels vs. water levels) characteristic of Anodonta and Unio underline the importance of mussels in biomonitoring. (Baker-FRC)
W82-06284

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,

LIBRARY U. OF I., URBANA-CHAMPAIGN

Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
Water Science and Technology, Vol 14, No 3 p 137-143, 1982. 19 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Reviews, Environmental effects, Sedimentation, Heavy metals, Metals, Pathogens, Dissolved oxygen, Water pollution effects, Public health, Shellfish, Aquatic life, Benthic fauna, Nutrients, Zooplankton, Phytoplankton, Fish, Organic matter.

A review of sludge disposal at sea by ships concerns the environmental effects on the sea surface, water column, and sea bottom. When sludge is dumped from a ship, the primary effects are a transient surface slick, a turbid plume, and deposition on the sea bottom. Little is known about the effects of sludge dumping on the neuston (surface community of organisms). but significant damage is unlikely. The water column contains increased nutrient levels. However, algal blooms sometimes attributed to sludge dumping grounds are often a result of input from rivers. Reduced dissolved oxygen has been recorded seasonally below the thermocline. The finely divided organic material serves as food for planktonic organisms. The main impact of sludge dumping is on the sea bottom. Dumping grounds are classified, although not rigidly, as accumulating and dispersing. Effects are most noticeable in accumulating dumping grounds. The sediment increases in organic content and may be deoxygenated below the surface, replacing the normal benthic community with a low diversity, high biomass assemblage, mostly worms. Toxic heavy metals and organochlorines accumulate in the dumping grounds and enter the food chain. Thus far, levels in seafood products have not been harmful. Pathogens may present a hazard to public health by contaminating shellfish. Some fin fish diseases are associated with sewage exposure. Impacts of sludge dumping on the ecosystem are generally local and reversible. (Cassar-FRC)
W82-06287

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,
Coastal Water Research Project, Long Beach, CA.
W. Bascom.
Water Science and Technology, Vol 14, No 3, p 41-52, 1982. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Environmental effects, Santa Monica Bay, California, Outfalls, Invertebrates, Fish, Aquatic animals, Toxicity, Canyons, Species distribution, Species diversity.

A steep-sided submarine canyon in Santa Monica Bay, California, has received about 1.25 million metric tons dry weight of sewage sludge over the past 22 years. Near the discharge at 100 m depth 41 species of fish and 40 species of invertebrates were found. Dominat species of fish at the outfall were soles, rockfish, croakers, sanddabs, perch, combfish, ratfish, and plainfin midshipman. Water was moderately clear away from the pipe. The ecosystem in a 3 sq km area of the canyon has experienced both beneficlal and detrimental changes. Species numbers are greatly reduced, sometimes to as few as 10, and the Infaunal Trophic Incexes often reach zero. At most of the canyon stations the number of individuals and the biomass was almost double that at the control stations. However, species are limited to those which can utilize the sludge as food. Individual fish were larger in the canyon area. (Cassar-FRC)
W82-06290

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,
Verlag Chemie, Weinheim (Germany, F. R.).
H. Bernhardt.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 14-26, February, 1981. 14 Fig, 7 Tab, 67 Ref.

Descriptors: *Water quality control. *Water pollution prevention, *Eutrophication, *Phosphorus removal, *Wastewater treatment, Drinking water, Nutrient removal, Filtration, Reservoirs, Nitrogen, Water suply, Water pollution control, Water pollution effects, Potable water.

The causes of eutrophication of still waters are reviewed along with processes for reducing phosphorus levels in the effluents of urban sewage treatment plants. Methods of contact filtration, chemical precipitation and adsorption of phosphorus compounds and the biological elimination of phosphorus and nitrogen are described. The international OECD investigation program was applied in calculating the tolerable phosphorus load of lakes and drinking water supply reservoirs in relation to the morphological conditions of the water bodies. Seepage filtration which reduces phosphorus input into reservoirs and lakes is examined. Alumina filtration is used to treat the effluents of fish hatcheries. The Wahnbach Reservoir Association has designed a process to eliminate phosphorus contributed from large tributaries of a reservoir. Similar measures which are utilized in the lakes of West Berlin that supply potable water are discussed. (Geiger-FRC)
W82-06299

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,
Kansas Water Resources Research Inst., Manhattan.
F. deNoyelles, and D. Kettle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256504, Price codes: Axx in paper copy, A01 in microfiche. Contribution No 219, December 1980. 48 p, 1 Fig, 15 Tab, 59 Ref. OWRT A-092-KAN(1), 14-34-0001-8018.

Descriptors: *Herbicides, *Aquatic weed control, Pollutants, Water pollution effects, *Agricultural runoff, *Atrazine, Kansas, *Aquatic food chains, *Phytoplankton, *Triazine herbicides, *Photosynthetic inhibitors, Zooplankton, Fish, Experimental ponds.

Experimental ponds were used for studying the effects of an agricultural herbicide on aquatic food chains. Atrazine, one of the most heavily used herbicides in Midwest agriculture, was added to ponds and the ensuing responses were followed through four months. With single 20 mu g/liter additions to the ponds, effects were recorded throughout the food chain. After one day of exposure rates of phytoplankton photosynthesis declined at both levels, with the higher level causing an almost complete inhibition. Phytoplankton succession was altered within a few days at both levels, with resistant species increasing in abundance. The actual resistance of these species to atrazine, which is known to be a photosynthetic inhibitor affecting a wide variety of plants, was verified in the laboratory. The grazing zooplankton were also affected within the first few weeks of exposure as their phytoplankton food source was altered. The growth of aquatic flowering plants was also reduced at both levels. Some members of the aquatic food chain were unaffected, particularly the benthic insects, although effects were recorded at the highest level of these food chains, the fish. Of the three types of fish (bluegill sunfish, channel catfish, gizzard shad) originally stocked in the ponds, all survived but with reduced growth at the 500 mu g/liter level. The only fish to reproduce in the ponds, bluegill sunfish, showed greatly reduced numbers of progeny at both levels. The concentrations of atrazine in the ponds were monitored, showing its persistence with 75% of the original concentration present after 114 days. In Midwest waters concentrations of 500 mu g/liter are recorded in waters directly associated with agricultural operations, such as irrigation waters while 20 mu g/liter is at the high extreme of concentrations found more widespread. Though data from monitoring atrazine concentrations in natural habitats is sparce 1 mu g/liter to 5 mu g/liter seem common in many Midwest waters. In laboratory experiments with these more common concentrations we also demonstrated reductions in phytoplankton phytosynthesis. This indicates the possibility, awaiting further demonstration, that even at common concentrations atrazine may be affecting phytoplankton photosynthesis in many Midwest waters. Other herbicides studies in this project included 5 other triazine herbicides (propazine, metribuzin, terbutryn, cyanazine, simazine) which in the laboratory were similar to atrazine in the intensity of reducing phytoplankton photosynthesis. In the State of Kansas triazine herbicides accounted for one-third of the total herbicide usage in 1978.
W82-06304

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-06310

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,
Arhus Amtsvandvaesen (Denmark).
J. M. Andersen.
Water Research, Vol 16, No 7, p 1119-1126, July, 1982. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Eutrophication, Phosphorus removal, *Phosphates, *Nitrates, Nitrogen, Sediments *Lake sediments, Hypolimnion, Thermal stratification, Stratification, Nutrients, *Denmark.

Results are given of eutrophication investigations in some 31 Danish lakes, focusing especially on the relationships between the concentration of oxidized nitrogen in the lake water and the binding or release of phosphorus to or from the lake sediment. Nine lakes were dimictic, with anoxic hypolimnia, and 22 were very productive and shallow polymictic lakes. Phosphate release from the sediment resulted in large increases in phosphate concentrations in the anoxic hypolimnion, if concentrations of oxidized nitrogen in the hypolimnion were less thant about 0.1 g N/cubic meters. If concentration of oxidized nitrogen in the hypolimnion was about 1 g N/cubic meter or higher, no release of phosphate from the sediment to the anoxic hypolimnion occurred. In lakes with no summer stratification a release of phosphate from the sediment to the well oxygenated water resulted in summer maxima of phosphate in the lake water when nitrate concentration in the water was less than about 0.5 g N/cubic meter, but no release took place if nitrate concentration exceeded about 0.5 g N/cubic meter. This effect of oxidized nitrogen in preventing phosphate release from the sediment demonstrates the ability of oxidized nitrogen to buffer the redox potential of the surface sediment at a level high enough to prevent a release of phosphate. Thus, among the efforts to limit phytoplankton biomass in lakes an artificial enrichment with nitrate may in some cases be an important supplement to the usually necessary reduction in phosphorus loading, but the possibility of a stimulation of phytoplankton growth through the addition of nitrate must be carefully considered. (Baker-FRC)
W82-06313

SOME EFFECTS OF PULP AND PAPER WASTEWATER ON MICROBIOLOGICAL WATER QUALITY OF A RIVER,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, S. Janhurst, and G. Horsnell.
Water Research, Vol 16, No 7, p 1291-1295, July, 1982. 3 Tab, 20 Ref.

Descriptors: *Water quality, *Industrial wastes, Rivers, Water pollution effects, *Pulp and paper industry, Bacteria, Public health, Recreational facilities, Fecal bacteria, Coliforms, Escherichia coli.

The source of fecal indicator bacteria was sought in a river downstream from Sturgeon Falls. A small sewage treatment plant treating 1 million gallons per day and serving the town of Sturgeon Falls discharges effluent to the river 2 km below the falls. Two 5-day bacteriological water quality surveys were carried out between June 25 and 29,

and August 10 and 14, 1977. Data were obtained from samples taken at 40 river locations. Above Sturgeon Falls the water quality in the river was fairly good. The principal input of fecal indicator bacteria was traced to the paper mill at Sturgeon Falls; however, other sources of indicator bacteria could have been masked by the large numbers of bacteria discharged by the mill. The principal fecal coliform was Klebsiella pneumoniae. In pulp mill wastes the fecal origin of this bacterium can be disputed. K. pneumoniae can cause illness in humans. Pseudomonas aeruginosa was detected in the pulp mill wastewater and at a level of 82 PA/100 ml in recreational waters. This level was considered hazardous to the water users. Escherichia coli was detected in mill wastewater at about 200 EC/100 ml; this probably indicated some measure of fecal pollution though probably of animal origin. Finally, the nutrient-rich wastewater led to an about 50-fold increase in density of aerobic heterotrophic bacteria in the river water, as well as the production of a slimy filamentous growth on surfaces, stones, and wooden pilings in the river. The principal organism in this slime was the fungus Leptomitus. (Baker-FRC)
W82-06315

THE IMPACT OF COMBINED SEWER OVERFLOWS ON THE DISSOLVED OXYGEN CONCENTRATION OF A RIVER,
Aalborg Univ. (Denmark). Dept. of Environmental Engineering.
T. Hvitved-Jacobsen.
Water Research, Vol 16, No 7, p 1099-1105, July, 1982. 10 Fig, 10 Ref.

Descriptors: *Dissolved oxygen, Rivers, *Storm water, *Storm-overflow sewers, Storm runoff, Storms, *Combined sewer overflows, Storm wastewater, Oxygen, *Denmark, Skravad River.

The impact on the water quality of receiving streams was studied for combined sewer overflows in Denmark. The investigation was carried out in the river Skravad, a small tributary to the river Skals located in the middle of Jutland, Denmark. The total length of the Skravad River is 25 km; the part studied has a length of about 4 km, and on the average a width of 2.5 meters and a depth of 0.25 meters. About 5.5 km upstream from the confluence with the Skals River the stream receives biologically treated wastewater from the Moldrup sewage treatment plant. Moldrup township has a combined sewerage system and covers an area of about 70 ha. The storm overflows discharge through a ditch to the river Skravad just downstream from the outfall from the sewage treatment plant. Immediate oxygen comsumption takes place during the passage of the bulk discharge due to degradation in the water phase and absorption at the bed. A delayed effect was noted on the dissolved oxygen concentration due to the degradation at the bed of settle particulate matter and/or adsorbed organic matter. The observed effect cannot be due to the delay of polluted water in the dead zone volume of the stream. Depending on the actual adsorption, sedimentation, desorption and resuspension, the observed delayed effect on the dissolved oxygen concentration will vary from one discharge event to another. The flow conditions in the stream may also be important. Due to the delayed effect, the oxygen depletion extends over a longer period than just the duration of the overflow. In the investigated river the oxygen concentration returned to dry weather conditions within 12-24 hours. (Baker-FRC)
W82-06316

THE EFFECT OF BOAT ACTIVITY ON TURBIDITY IN A SHALLOW BROADLAND RIVER,
Freashwater Biological Association, Windmere (England).
J. Hilton, and G. L. Phillips.
Journal of Applied Ecology, Vol 19, No 1, p 143-150, April, 1982. 4 Fig. 2 Tab, 7 Ref.

Descriptors: *Turbidity, *Boating, Rivers, Lakes, Recreation facilities, Water quality, Model studies, Mathematical equations, Algal growth, Eutrophication, Water pollution sources.

A new approach was developed to explain the possible mode of action of boat activity in a narrow, shallow river and by its application, answer some problems of recreational management. The study site was the River Ant, a tributary of one of the principal Broadland rivers, the River Bure. The river flows throught Barton BroaD, a shallow lake of 1 meter in depth, 70 ha in area. During the summer the Broad and the river downstream contain a very high standing crop of phytoplankton. Above the Broad very little phytoplankton develops. the river is navigable for several miles above the Broad, and two large boat-hire yards are located in these upper reaches. Boat activity throughout the navigable reaches can be as high as 100 boats moving per hour. A simple experimental model was proposed and tested. It describes the mechanism by which boats can influence turbidity. Of the three constants derived from the model, two were shown to be closely related to measured physical variables. The model was used to predict water turbidities from typical boat movement patterns. This demonstrated that long term buildup of boat-induced turbidity through the holiday season was unlikely and that the major part of the turbidity in and below Barton Broad on the River Ant was due to algae and not to boating activity. (Baker-FRC)
W82-06330

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,
Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, B. Keswick, R. L. LaBelle, C. P. Gerba, and Y. Sanchez.
Journal of the American Water Works Association, Vol 74, No 6, p 318-321, June, 1982. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Well water, *Human diseases, Drinking water, Bacteria, Potable water, Contamination, Leaching, Gastroenteritis, Hepatitis, Viruses, *Kentucky, Georgetown.

This report describes the Georgetown experience of an outbreak of gastroenteritis and hepatitis in order to illustrate the problems of viral contamination of small community water supplies. This marks the first reported instance of hepatitis A virus (HAV) antigen detection in well water samples taken prior to a hepatitis epidemic. In June of 1980 an outbreak of gastrointestinal illness occurred in the town. The outbreak began on June 1 and was over by June 23, with the peak number of cases occurring on June 13. Illness was associated with drinking of water from the central city wells. The attack rate among the 10,000 people living in areas supplied by these wells was about 79%. An increase in the number of cases of hepatitis A began to appear in July of that year. Again the cause was traced to central city wells. Heavy rainfalls had preceded the outbreaks of both gastroenteritis and hepatitis. Samples were taken from sewage, well water, and tap water for virological analysis. It was concluded that the Georgetown outbreak may have occurred due to heavy fecal contamination of the groundwater source near the central-city wells. What would normally be adequate treatment for an uncontaminated groundwater source was clearly inadequate when that source became unexpectedly contaminated. Human enteric viruses were isolated from the potable water in spite of a total chlorine residual of 0.8 mg/L. Sources of the contamination may include leakage from nearby sewer lines, contamination from nearby abandoned or private wells or septic tanks, and relatively long-distance contamination from surface contaminants in the recharge area of the Edwards aquifer. There is a fault line in the area adjacent to the wells and the aquifer is exposed to the surface just west of the fault line. (Baker-FRC)
W82-06348

ANTAGONISM OF SELENIUM AND CADMIUM PRETREATMENTS TO SUBSEQUENT EMBRYOTOXIC DOSES OF MERCURY AND CADMIUM IN FISH EMBRYOS,
South Dakota Univ., Vermillion. Water Resources Inst.
J. F. Heisinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256645, Price codes: A02 in paper copy, A01 in microfiche. Report, December, 1981. 20 p, 2 Fig, 1 Tab, 31 Ref. OWRT A-075-SDAK(1). 14-34-0001-0144.

Descriptors: *Selenium, *Liver, *Embryonic growth stage, *Heavy metals, *Fish toxins, Mercury, Cadmium, Toxicity, Trace metals, Trace elements, Trace levels, Fish, Water pollution, Pollutants, Environmental protection, Fish populations, Population exposure.

Research was carried out to assess the protective role of selenium (Se) and cadmium (Cd) pre-exposures to fish embryos in attentuating toxic doses of mercury (Hg) and Cd. Experiments were carried out under laboratory-controlled conditions using Japanese ricefish (Oryzias latipes). Results indicated a protective role of Se pretreatment against Hg and Cd exposures in fish embryos once the liver has developed. In addition, pretreatment of post-liver embryos with sublethal concentrations of Cd also affords protection against subsequent potentially lethal Cd exposures. These antagonistic interactions, however, appear not to occur prior to liver development. Since numerous antagonistic metal and metalloid interactions have been reported in adult vertebrates, and since it is established that most metal-polluted waters contain anomolous quantities of more than one toxic element, it might be expected that the toxicity of these waters would be less than the sum of the toxic effects of the individual metals. However, during early embryo development the requisite morphological and molecular characteristics for antagonistic interactions appear to be lacking; consequently, younger embryos will lack sufficient resistance to multiple toxic metal exposures and lethality may occur. The results confirm the hypothesis that, during early embryonic development, the protective effects of Se or Cd will be nonexistant or minimal. (Zielinski-MAXIMA)
W82-06371

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.
Organization for Economic Co-Operation and Development, Paris (France).
Report, 1982. 154 p, 46 Fig, 24 Tab, 154 Ref, 7 Append.

Descriptors: *Eutrophication, *Eutropic lakes, *Water quality control, *Phosphorus removal, *International commissions, Algal growth, Aquatic productivity, Inland waterways, Water quality, Phosphorus, Nutrient removal, Nutrients, Nitrogen, Monitoring, International agreements, Trophic level, Lake morphology, Limnology.

The principal results are presented of a multi-year, 18-country international cooperative program aimed at establishing a basis for eutrophication control of inland waters (especially lakes and reservoirs) and developing improved guidelines for fixing nutrient load criteria compatible with water use objectives. The program was carried out by establishing four main regional projects covering a wide variety of geographic and limnological situations (Alpine; Nordic; reservoir and shallow lakes; and North Anerica); a fifth report has been developed which tests the results on bodies of water not included in the analytical part. The main control strategy offered is reduction of the external load; where this is impractical/impossible, alternate management measures are necessary which can only be defined using advanced modeling techniques. While nitrogen (or another factor) may occasionally outweigh the role of phosphorus (P) as the limiting factor, attention is focused on phosphorus control. The program results showed that, in most cases, P is the factor which determines eutrophication development; even when another element (e.g., nitrogen) is the limiting factor, P may still be made to play the limiting factor role through appropriate control. Specific findings concerning monitoring, nutrient load assessment, trophic assessment, and loading criteria and nutrient

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reduction goals are discussed. (Zielinski-MAXIMA)
W82-06383

STUDIES OF BOD INHIBITION IN PRESENCE OF INORGANIC HEAVY METALS,
Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 111-113, June, 1981. 4 Tab, 5 Ref.

Descriptors: *Biochemical oxygen demand, *Chemical interference, Water Analysis, *Heavy metals, Toxicity, Water pollution effects, Inhibition, Biodegradation, Cadmium, Chromium, Mercury, Coppper, Dissolved oxygen, Sewage bacteria, Industrial wastes.

The method of estimating biochemical oxygen demand (BOD) on the basis of rate of oxygen consumption may lead to erroneous results when inorganic toxicants, either individually or in combination, are present in samples of sewage or polluted water. Copper (Cu), chromium (Cr), cadmium (Cd), mercury (Hg), and other electroplating wastes may kill the microbial population in the sample, leading to a reduced depletion of dissolved oxygen concentration. BOD inhibition due to Cu, Cr, Cd, and Hg, individually and in combination, was determined by adding different concentrations of the metals for different dilution factors of sewage and dilution water. Toxicity behavior analysis showed that percent inhibition of BOD fluctuated for concentrations of 0.01 to 0.1 ppm for all of the toxicants. For 0.01 to 0.1 ppm levels of the metals, toxicity to microbial populations was within the range of 25% inhibition of BOD. For the concentration of 0.1 to 1.0 ppm, Cr seemed to be the least toxic and Hg the most. In the case of each metal tested, biodegradation activity as almost soppped in the concentration range of 1.0 to 10 ppm. Metals in combination were less toxic than individually. (Geiger-FRC)
W82-06436

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang.
Hydrobiologia, Vol 87, No 3, p 193-200, March, 1982. 2 Tab, 4 Fig, 19 Ref.

Descriptors: *Primary productivity, *Algae, *Sediment, *Settling basins, *Transparency, Phosphorus, Eutrophication, Water treatment, Water quality, Reservoirs, Water supply, Sewage effluent, River basin development, Silt, Reservoir operation, Lake Monroe, Indiana.

Lake Monroe is the largest body of water in Indiana. Studies were undertaken to determine the annual production rates and trophic status of the lake. The result then served as a basis for interpreting data on the subsequent nutrient enrichments. C-14 bioassays with enrichments of major and minor nutrients were conducted, and algal response to different light availability conditions was investigated. The diurnal changes in major nutrients and carbon, nitrogen, and phosphrous ratios were examined. Results indicated that phosphorus is the major limiting nutrient on algal photosynthesis in this lake. Surface photo-inhibition may be used to indicate the sufficiency of light for the species of algae in the water. The low productivity in December, January, February, and early March can be attributed to light limitation due to the low water transparency. (Titus-FRC)
W82-06470

CIRCULATION PATTERNS; THEIR INVESTIGATION AND PREDICTION,
Leicester Polytechnic (England). School of Life Sciences.
For primary bibliographic entry see Field 5F.
W82-06477

DIATOM DISTRIBUTION AND STATUS OF ORGANIC POLLUTION IN SEWAGE DRAINS,
Delhi Univ., New Delhi (India). Dept. of Botany.
K. M. M. Dakshini, and J. K. Soni.
Hydrobiologia, Vol 87, No 3, p 205-209, March, 1982. 1 Tab, 1 Fig, 14 Ref.

Descriptors: *Diatoms, *Sewage, *Nitrate, *Indicator species, *Organic wastes, Nitrogen, Water quality, Organic matter, Organic loading, Correlation analysis, Water sampling, Ammonia, Sewers, India, River Yamura.

Data on the limnology of various sewage drains discharging into the River Yamuna in Delhi, India, suggest that the diatom distribution and concentration of nitrate nitrogen vary with the degree of organic pollution. Surface water samples were collected from each drain in three different seasons throughout a one year period. The samples were analyzed for physiochemical characteristics and diatom composition. In the drains investigated, diatoms, nitrate nitrogen and dissolved oxygen were generally highest in winter, high in the post-monsoon period and low in summer. Such a uniform seasonal trend was not evident for ammonia nitrogen and chemical oxygen demand. Detailed autecological studies are required before a final relationship between diatom density and the organic content of sewage can be stated. (Titus-FRC)
W82-06484

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters, and M. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 785-790, May, 1982. 1 Fig, 3 Tab, 25 Ref.

Descriptors: *Phosphorus, *Lakes, *Regression analysis, *Particulate matter, *Seston, Nutrients, Phosphorus compounds, Phosphates, Water analysis, Surface water, Mathematical studies, Rivers, Reflectance, Lake Memphremagog, Quebec.

The amounts of colored particulate matter measured by reflectance in the surface waters of Lake Memphremagog and its tributaries were regressed against levels of total phosphorus (P), particulate P, soluble reactive P, orthophosphate, large molecular weight P (> 5000) and small molecular weight P (< 400) to see which fraction was the best predictor of seston concentration, and to determine if riverine samples differed from lake waters in the relationship between P levels and suspended particulates. Total P correlated with colored particulates better than any other fraction in both lotic and lentic environments. Regression lines describing the relations were similar in both lakes and rivers, although river samples showed greater variation than lake samples. These findings, confirm the retention of total P as the simplest and most meaningful measure of this important nutrient in both lakes and rivers. (Geiger-FRC)
W82-06496

ENVIRONMENTAL IMPROVEMENT AT PORT ALICE, B. C.,
E. V. S. Consultants, Inc. Seattle, WA.
E. M. Tokar, J. P. Campbell, and R. Tollefson.
Pulp and Paper Canada, Vol 83, No 5, p 50-53, May, 1982. 4 Fig, 2 Ref.

Descriptors: *Pulp and paper industry, *Fish, *Toxicity, Water pollution effects, Aqutic life, Salmon, Dissolved oxygen, Water quality, Benthic fauna, Pulp wastes, Port Alice, British Comumbia, Neroutsos Inlet.

Pollution control equipment (including an incineration system) installed at the Western Forest Products Ltd. pulp mill at Port Alice, British Columbia, during 1971-77, dramatically improved dissolved oxygen concentrations and suspended solids in the receiving waters. Neroutsos Inlet on Vancouver Island. Surveys during 1978-80 showed a reduction in BOD discharge from a high of 227,000 to 70,000 kg per day. Average dissolved oxygen increased from 3 to 5 ppm. Primary productivity and intertidal organism numbers and diversity decreased in waters close to the mill, but the size of the affected zone has decreased. Chum salmon appeared to avoid certain areas of the inlet near the mill. In laboratory tests the biomass of juvenile chum salmon was not affected until effluent concentrations were 0.10-0.25 of the 96 hour LC50 on a continuous basis. Nevertheless, healthy fish populations exist in the inlet, as they apparently did even during the years before pollution abatement measures were started. (Cassar-FRC)
W82-06515

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,
Maryland Univ., College Park. Dept. of Microbiology.
F. L. Singleton, R. W. Attwell, M. S. Jangi, and R. R. Colwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 1080-1085, May, 1982. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuaries, *Microbiological studies, *Water pollution effects, *Vibrio cholerae, Aquatic life, Laboratory studies, Salinity, Nutrients, *Organic matter, Decomposing organic matter.

An investigation was performed on the possibility of employing microcosms to determine the influence of selected environmental parameters on growth and survival of a toxigenic strain of Birio cholerae in the aquatic environment as a means of establishing the autochthonous estuarine source of V. cholerae. Over the range of conditions tested, this strain of V. cholerae showed maximum response, as determined by increased plate counts and direct microscopic counts in microcosms prepared with a chemically defined sea salts solution at a salinity of 25%. With lower or higher salinity levels, the maximum population size declined. When added organic concentrations of less than 1,000 micrograms/liter were present, a marked salinity effect on the growth of V. cholerae was detected. However, at or above an organic nutrient concentration of 1,000 micrograms/liter, the need for an optimum salinity level was spared. From the results of this study it was concluded that V. cholerae can grow under conditions of organic nutrient concentration and salinity typical of estuaries. Results obtained support the hypothesis that V. cholerae is an autochthonous member of the estuarine microbial community. (Baker-FRC)
W82-06534

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,
Technion--Israel Inst. of Tech., Haifa.
Y. Azov, G. Shelef, and N. Narkis.
Applied And Environmental Microbiology, Vol 43, No 2, p 491-492, February, 1982. 2 Fig, 7 Ref.

Descriptors: *Algae, *Detergents, *Oxidation ponds, Municipal wastewater, *Wastewater treatment, Algal toxins, Israel, Water pollution effects, Wastewater farming.

High-rate oxidation ponds are used in Israel to combine wastewater treatment with the production of algal biomass to be used as a protein-rich animal feed. There has been some concern regarding the inhibitory effects of anionic non-biodegradable detergents on algal growth in these oxidation ponds. This study of the effect of detergents on algal production showed that regular concentrations of hard detergents in domestic wastewater did not affect algal growth in high-rate oxidation ponds. The addition of nonionic hard detergent at concentrations exceeding 60 milligrams per liter decreased algal concentration in the batch culture. Concentrations of detergent exceeding 100 milligrams per liter had a severe effect on algal morphology, with complete lysis of the algal cells occurring within a few days. These results indicate that only a considerable increase in the use of hard nonionic detergents or feeding the pond with in-

dustrial wastewaters which contain high concentrations of hard detergents would cause a severe inhibition of algal production. (Carroll-FRC)
W82-06538

EFFECT OF SULFIDE ON NITROGEN FIXATION IN A STREAM SEDIMENT-WATER SYSTEM,
Waterloo Univ. (Ontario). Dept. of Biology.
T.-Y. Tam, C. I. Mayfield, W. E. Inniss, and R. Knowles.
Applied and Environmental Microbiology, Vol 43, No 5, p 1076-1079, May, 1982. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Nitrogen fixation, *Sediments, Streams, Chemical reactions, Sulfides, Hydrogen sulfide, Acidity, Oxidation-reduction potential, Nitrogen, Carbon dioxide, Ethylene, Anaerobic conditions, Coastal waters, Laboratory studies, Marine waters, Estuaries, *Ontario.

Nitrogen fixation in a sediment-water system was studied under anaerobic laboratory conditions. Sediment and water samples were obtained from a stream near Floradale, Ontario, Canada. The presence of Na2S at concentrations from 2 to 8 micromol/ml of stream water stimulated nitrogen fixation by the system. A twofold increase in total ethlyene produced compared with the controls was noted when the sulfide concentration was 8 micromol/ml. Na2S concentrations of 16 to 32 micromol/ml inhibited nitrogen fixation, with total inhibition occurring at 64 micromol/ml. Ethylene production was not noted in sterile controls. Carbon dioxide production was inhibited by sulfide at concentrations from 8 to 128 micromol/ml. The degree of inhibition increased as the concentration of sulfide increased, and complete inhibition of carbon dioxide production occurred at 128 micromol/ml. Titanium(III) citrate, a strong reducing agent, stimulated both nitrogen fixation and carbon dioxide production. Sulfide additions caused pH changes in the sediment, and when the sediment was adjusted and maintained at pH 7.0 all concentrations of sulfide inhibited nitrogen fixation activity. From considerations of the redox equilibria of hydrogen, hydrogen sulfide, and other sulfur species at various pH values, it appeared that hydrogen sulfide was the toxic entity and that HS(-) was less toxic. The observed stimulation of activity was apparently due to a pH change coupled with the concurrent production of HS(-) from hydrogen sulfide. (Baker-FRC)
W82-06540

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
M. A. Holder-Franklin.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 124, 1981. 107 p 28 Fig, 40 Tab, 147 Ref.

Descriptors: *Saint John River, *Meduxnekeag River, *Dunbar River, Taxonomy, Methodology, Aquatic populations, Organisms, Sediments, Diurnal variations, Mathematical models, Pollutants, *Bacterial populations, Physico-chemical parameters, Isolates, Culturing procedures, Temperature factors, Oxygen levels, Nutrients, *New Brunswick, Maine, *Heterotrophic bacteria.

Population shifts in heterotrophic aquatic bacteria from a watershed with several months of ice cover annually and a temperature range of 0C to 28C have been studied by classical and numerical taxonomy, factor analysis and species diversity. Mathematical techniques have been utilized to demonstrate correlations between changes in the bacterial populations and certain physico-chemical environmental parameters. A complete methodology has been developed, beginning with isolation and culturing procedures and proceeding through the taxometrics to the multivariate statistics and the selection of correlation coefficients. This series of reports is a retrospective of work over a period of ten years and describes the seasonal and diurnal changes in the predominant flora in the free-flowing river and the sediment. The major environmental influences in each econiche are related to the bacterial flora. Although the bacterial population can be shown to fluctuate diurnally and seasonally, the overall predominant taxonomic groups in all locations in all seasons are the Pseudomonas, with the fluorescent group generally predominant in the winter and the non-fluorescent species prevailing during other seasons. The most important group are the gram-negative rods and of these the aerobic group dominate. The aerobes are followed by the facultative aerobes and members of the Enterobacteriaceae appear with moderate frequency in the high-profile segment of the population. The environmental parameters which have the most significant influence on the flora are the temperature; oxygen levels; the nutrients, particularly the amount and form of nitrogen; and the specific conductivity. (WATDOC)
W82-06558

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,
For primary bibliographic entry see Field 5A.
W82-06560

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,
For primary bibliographic entry see Field 5A.
W82-06562

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,
For primary bibliographic entry see Field 5A.
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06566

A REVIEW OF BENZOTHIAZOLES IN THE AQUATIC ENVIRONMENT,
Canada Centre for Inland Water, Burlington (Ontario).
B. Brownlee, J. H. Carey, and M. E. Fox.
National Water Research Institute, Scientific Series No 126, 1981. 5 p, 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Reviews, *Pollutant identification, *Benzothiazoles, Chemical properties, Biological properties, Aquatic environment, Toxicity, Water extracts, Air emissions, Waste water, Gas chromatography, Environmental contaminants.

The following aspects of benzothioazoles are reviewed: (1) physical and chemical properties, (2) analysis and occurrence, (3) biological properties and (4) mammalian toxicity and human health. Six reports were found in the literature on the occurrence of benzothioazoles in the following areas of the aquatic environment: river water (1-2ppb), drinking water, and tire plant wastewater (20-60ppb). Benzothiazoles display a wide range of biological activity and are used commercially as fungicides. No data were found for toxicity to aquatic organisms, although acute mammalian toxicity is low. Future research areas are identified, the most important of which are (1) physical properties, (2) persistence and (3) aquatic toxicity. (WATDOC)
W82-06571

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W82-06600

HYDROGEN SULFIDE CORROSION OF THE BAGHDAD TRUNK SEWERAGE SYSTEM,
M. I. Aldred, and B. G. Eagles.
Water Pollution Control, Vol 18, No 1, p 80-96, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Hydrogen sulfide, *Corrosion, *Main sewers, Sewer systems, Concretes, Baghdad, *Iraq, Middle East.

The corrosion of the trunk sewer and its main branches in Baghdad, Iraq, was investigated. The city, built on the East and West Banks of the River Tigris, is situated on a flat alluvial plain having little natural fall for drainage systems. As a result, sewage lift stations must be installed at frequent intervals. Construction on the East Bank's outfall sewer began in 1959, while the construction of the trunk sewers on the West Bank began in 1970. The main factors contributing to the production of hydrogen sulfide in the Baghdad sewerage system include the hot dry climate, low flow conditions, the high-strength sewage, the storage or retention period within the sewerage system, and poor natural ventilation of the system. Examination of the concrete sewers at about 190 manholes on the East Bank showed that all had been subject to attack by hydrogen sulfide and that the lower portions of the access ladders were surrounded with fallen pasty cementitious mass. Manhole ventilations did not appear to be related to attack by this gas. Sampling of industrial effluents entering the sewer system indicated that treatment of these effluents was generally limited to grease traps and small sedimentation tanks. Nearly all the discharges exceeded limitations on pollutants. Available methods of sulfide control include ventilation and odor control, pH control, aeration, chlorination, nitrate dosing, injection of hydrogen peroxide and oxygen, improved treatment of industrial effluents, and improved sewer maintenance. In the new system, pretreatment with hydrogen peroxide or oxygen at the pumping station should help keep sulfides low. Several recommended remedial actions are discussed. (Carroll-FRC)
W82-06651

EFFECTS OF SUSPENDED VOLCANIC SEDIMENT ON COHO AND CHINOOK SALMON IN THE TOUTLE AND COWLITZ RIVERS,
Washington Univ., Seattle. Fisheries Research Inst.
Q. J. Stober, B. D. Ross, C. L. Melby, P. A. Dinnel, and T. H. Jagielo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256801, Price codes: A09 in paper copy, A01 in microfiche. Report FRI-UW-8124, November, 1981. 146 p, 48 Fig, 25 Tab, 36 Ref, 1 Append. OWRT C-00238-V(No 1417)(1), 14-34-0001-1417.

Descriptors: *Salmon, *Bioassay, *Volcanoes, *Fallout, *Suspended sediments, Suspended solids, Water quality, Assay, Histology, Sediments, Suspended load, Biological properties, Chemical analysis, Water analysis, Gills, Fish physiology, *Washington, Cowlitz River, Toutle River.

Toleranes of Coho and Chinook salmon to suspended volcanic (Mount St. Helens) sediment were determined by live-box and static laboratory bioassays. The 96-hour LC-50 suspended sediment levels determined by live-box bioassay for presmolt and smolt Coho, and fall Chinook smolts were 1217, 509, and 488 mg/liter, respectively. Static 96-hour LC-50 values for Coho and fall Chinook smolts in mudflow sediment were 29,580 and 11,000 mg/liter. While live-box bioassays integrate numerous water quality parameters, only suspended sediment was tested. Other tests run in artificial streams (0.5-1.5 liter/sec flowrate) having known suspended sediment levels (0-16% of 96-hour LC-50 value) evaluated for sublethal effects (swim performance, seawater entry test) showed no consistant effect. Histological analysis of field/laboratory-tested salmon showed no suspended sediment effect on gill tissue. The results are compared to actual Coho presmolt mortality data following the Mount St. Helens eruption. Water quality data (e.g. trace metals) and sediment particulate size measurements are included. The volcanic ash had

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particle sizes equivalent to silt-fine sand and was high in silica, magnesium, and iron. (Zielinski-MAXIMA)
W82-06706

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256819, Price codes: A02 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 81, December, 1981, Knoxville. 13 p, 1 Fig, 2 Tab, 16 Ref. OWRT A-057-TENN(1), 14-34-0001-0145.

Descriptors: *Toxins, *Water reuse, *Catfish, *Recirculated water, Fish toxins, Hazardous materials, Fish, Neutralization, Biological properties, Biochemical tests, Bioassay, Assay, Antibiotics, Proteins, Toxicity, Wastewater renovation, Water quality.

Channel catfish serum contains an immunoglobulin (IgM), 14S-macroglobulin. It was determined that the catfish immune serum could neutralize tetanus toxin (TT) at the 1.28 antitoxin units (AU/ml) level, and that catfish 14S-macroglobulin (11.3 mg/ml) from Sephadex G-200 gel filtration could neutralize TT at the 0.32 AU/ml level. The 0.01 AU/ml level of TT neutralization is considered to be the minimal level needed for protection in humans. After 2-mercaptoethanol (2ME) reduction and alkylation, no TT neutralization by the catfish immune serum or by the 14S globulin remained. The catfish 7S globulin (40 mg/ml) had no TT neutralizing ability either before/after 2ME reduction and alkylation. Decreases in 14 S and 7S globulin titers after 2ME reduction and alkylation indicated that both globulin fractions were sensitive to sulfhydryl reduction. Catfish reciprocal indirect hemaglutination titers were 2048 10 days after primary immunization and did not rise above 8192 even after 10 months post-primary immunization. Not until after the first booster dose of 0.5 ml toxoid was given at 10 months, post-primary immunization was a protective TT neutralization level (0.08 AU/ml) found, with titers still at 8192. This indicates an IgM antibody memory response for TT neutralization by the channel catfish. (Zielinski-MAXIMA)
W82-06707

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,
Oklahoma Univ., Norman. Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W82-06710

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,
State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
E. L. Rowe, R. J. Ziobro, C. J. K. Wang, and C. W. Dence.
Environmental Pollution, Series A, Vol 27, No 4, p 389-396, April, 1982. 3 Tab, 20 Ref.

Descriptors: *Bleaching wastes, *Algae, Toxicity, Chlorination, Chlorine, *Chlorophenols, *Chlorinated hydrocarbons, Aquatic plants, *Duckweed, *Bioassays, Water quality.

The toxicity of a number of compounds, primarily chlorophenols, present in spent pulp bleaching liquors was investigated toward a freshwater unicellular alga, Chlorella pyrenoidosa, and a duckweed, Lemna perpusilla. In addition to individual compounds, the effect of the whole spent chlorination and caustic extraction liquors on the alga was also determined. Test chemicals included catechol, 4,5-dichlorocatechol, 3,4,5-trichlorocatechol, tetrachlorocatechol, phenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, guaiacol, 4,5-dichloroguaiacol, 4,5,6-trichloroguaiacol, 9,10-epoxystearic acid, p-cymene, monobromo-p-cymene, and dichloro-p-cymene. The study indicated that the toxicity of the chlorine substituted compounds was greater than that of the parent compounds and that increasing numbers of chloro substituents resulted in increased toxicity. Spent chlorination liquor was more toxic to the alga than spent caustic extraction liquor. The comparatively severe toxic effects of the catechol compounds on the alga and duckweed in this study duplicate the findings of earlier studies with Daphnia. The comparatively low toxicity of epoxystearic acid toward the alga and duckweed were compatible with findings on juvenile rainbow trout, Salmo gairdneri. Both test organisms used in this study proved satisfactory for evaluating the toxicity of compounds identified in spent chlorination and caustic extraction liquors and were superior for this purpose to the fungi examined in previous studies. (Baker-FRC)
W82-06721

FURTHER OBSERVATIONS ON THE EFFECT OF ABATE ON FISH CATCHES,
Ghana Inst. of Aquatic Biology, Achimota.
E. K. Abban, and J. Samman.
Environmental Pollution, Series A, Vol 27, No 4, p 245-254, April, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Fish populations, *Larvicides, Pesticides, Rivers, Volta Basin, *Ghana, Savanna rivers, *Abate, Seasonal variations, Aquatic life, Ecosystems.

A short term evaluation was made of the effects of Abate in relation to fish and fisheries. Specifically, effects of the weekly application on fish catches during the long dry season from November to May in Northern Ghana are reported. Such dry periods are typical of the savanna regions of the Onchocerciasis Control Program (OCP) area of the World Health Organization. The study was conducted on the White Volta, a major river in the Volta Basin. The river at this time existed mainly as a series of slow flowing pools connected by relatively shallower and faster flowing sections. The study period lasted 11 days, during which time Abate was applied aerially directly to the river. Fish samples were taken about 1 km from the dosing point. In the OCP Abate is applied at a dosage rate of 0.04 ppm for each 10 minutes of river discharge. Each sample consisted of fish caught in a battery of nets in 12 hr. Following the larvicide application on 20 May, six day and six night samples were taken before the next treatment on 27 May. No fish kills were noted that could be associated with Abate treatment on the river. Fish normally avoided the larvicide by moving downstream. However, when the fishes' movements were restricted due to the low water, they did undergo stress-movements, which increased their proneness to capture in nets. It is evident that during the dry season regular treatment of rivers may expose fish to the larvicide for longer periods than expected. (Baker-FRC)
W82-06722

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,
Military Engineering Services, Hyderabad (India).
R. C. Sehgal, and Y. Jaluria.
Energy, Vol 7, No 5, p 419-428, May, 1982. 7 Fig, 17 Ref.

Descriptors: *Thermal pollution, *Flow pattern, Powerplants, Thermal powerplants, *Thermal water, Heated water, Waste heat, Temperature effects, *Model studies, Isotherms, Temperature gradients, Thermoclines.

The turbulent recirculation that occurs due to thermal discharge to a shallow water body has been studied. A horizontal, two-dimensiional model was developed to determine the nature of the flow field generated. The model assumes complete mixing in the vertical direction and steady ambient conditions. Various configurations of the intake and outfall are considered, and the intake water temperature is determined as a function of the heat rejected. It is found that the spread of the flow region is a strong function of the flow configuration and of the distance between the outfall and the intake. The intake temperature was found to be insensitive to the amount of heat rejected at low values of the rejection rate. At large values, however, a strong dependence is observed, and the intake temperature rises sharply with heat rejected. The effect of turbulent mixing in the water body due to winds, inflow, level changes and other causes is considered in terms of the eddy diffusivities, and a relatively weak dependence over the range of interest is indicated. The streamlines and isotherms under various conditions of inflow, ambient conditions and amount of heat rejected per unit area are determined. The results are compared with a simple one-dimensional model. The study indicates the water surface region over which significant transport processes occur. These results can be employed in one-dimensional vertical models to obtain the effective surface area for heat rejection, determine the stratification that results, and find the transient behavior of the water body. The results are directly applicable to shallow water bodies and to those in which good vertical mixing exists. The study provides a basis for the design of such heat rejection systems, particularly with respect to the horizontal separation of the intake and outfall. (Baker-FRC)
W82-06723

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
K. G. Wetzel.
Ambio, Vol 11, No 2/3, p 126-131, 1982. 5 Fig, 1 Tab, 8 Footnotes.

Descriptors: *Water supply, *Nuclear explosions, *Radioisotopes, *Drinking water, Disasters, Agriculture, Industrial water, Groundwater pollution, Surface water, Fate of pollutants, Radioactivity, Air pollution, Streams, Rivers, Reservoirs, Aquifers, Lakes, Public health, Toxicity, Water pollution effects, Fallout, Rain, Disasters, War.

The radioactive contamination of freshwater supplies after a global nuclear war is estimated for a lowland temperate climate. Regions exposed to local fallout would be contaminated with the persistent and toxic I-131, Sr-89, Sr-90, and Ru-106 and with other radioisotopes with shorter half-lives; regions exposed to global fallout only, with I-131. The most serious contamination would come from radioactive rain water, followed by rivers, lakes, and least affected, groundwater reservoirs. In the most severely impacted areas, rain water would be so highly loaded with I-131 that skin contact would produce visible changes to the skin within several days. Rainfall could also wash radioactive fallout into concentrated areas, enhancing radioactivity levels by 10 to 100 times. Well-mixed lakes with long residence times would dilute radioactivity better than other lakes. Stream water in direct fallout regions would exceed maximum drinking water concentrations for about 4 weeks and in global fallout regions, for 2 weeks. Groundwater would be reasonably safe for drinking except in aquifers with short residence times (a few years or less), aquifers covered by sediments low in ion exchange capacity, or soil layers less than 1 meter thick. In general groundwater contamination in directly exposed regions would have about one-tenth the radioactivity of stream water. Much worse contamination of surface water would be expected in montiform, karstic, permafrost, desert, and marshland regions. Semi-arid regions would have higher contamination than tropical regions, which would receive about half the fallout of temperate regions. The Southern Hemisphere would be less affected by a factor of 0.03. (Cassar-FRC)
W82-06733

PRODUCTION AND VERTICAL FLUX OF ATTACHED BACTERIA IN THE HUDSON RIVER OF THE NEW YORK BIGHT AS STUDIED WITH FLOATING SEDIMENT TRAPS,

Lamont-Doherty Geological Observatory, Palisades, NY.
H. W. Ducklow, D. L. Kirchman, and G. T. Rowe.
Applied and Environmental Microbiology, Vol 43, No 4, p 769-776, April, 1982. 3 fig, 5 Tab, 30 Ref.

Descriptors: *Plumes, *Bacteria, Rivers, *Hudson River, Sedimentation, Measuring instruments, Sediment sampler, Fluctuations, Diatoms, Particulates, Mineralization, Organic carbon, Organic compounds, Water temperature, Nutrients, *New York Bight.

The growth and vertical flux of attached bacteria were investigated with floating sediment traps in the Hudson River Plume of the New York Bight during the spring diatom blooms. Traps were floated at the base of the mixed layer for 1 day periods. After recovery bacterial abundance and rates of (methyl-3H)thymidine incorporation were measured in the trap samples. The vertical flux of attached bacteria was estimated with a model formulated to distinguish between bacterial accumulation in traps due to in situ growth and that due to vertical flux. The results indicated that in situ growth of bacteria in sediment traps was unimportant as a source of bacterial increase when compared with vertical flux during this study. The vertical flux of attached bacteria removed 3 to 67% of the total daily bacterial production from the water column. Particulate organic carbon was not significantly mineralized by attached bacteria during its descent to the sea floor in the plume area during this period, when water temperature and grazing rates were at their annual minima. (Baker-FRC)
W82-06736

EFFECTS OF ACID ON PLANT LITTER DECOMPOSTION IN AN ARCTIC,
Cincinnati Univ., OH., Dept. of Biological Sciences.
V. L. McKinley, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 5, p 1188-1195, May, 1982. 5 Fig, 1 Tab, 37 Ref.

Descriptors: *Decomposing organic matter, *Hydrogen ion concentration, *Lakes, Polar regions, Arctic, Arctic zone, Acid rain, Precipitation, Litter, Plants, Acidity, Microbial degradation, Aquatic plants, Toolik Lake, *Alaska, Oligotrophic lakes.

The effects of acidic pH on the microbial decomposition of plant litter were studied during the summer of 1980 in microcosms from Toolik Lake, Alaska. Toolik Lake is a large, deep water lake on the north slope of the Brooks Range of mountains within the Trans-Alaska Pipeline corridor. It is very oligotrophic and its waters have very little buffering capcaity. Microbial decompostition of Carex in response to acidification was evaluated directly by determinations of weight loss and changes in C/N rations of the litter over time. Microbial biomass and activity associated with the litter were evaluated by the measurement of adenosine triphosphatase concentrations and by determination of the rates of acetate incorporation into microbial lipids, respectively. The community structure of the microbiota on the litter surface was examined by scanning electron microscopy and the effects of acid on the mineralization of Carex lignocellulose were also examined. Microbial activities associated with Carex litter were significantly reduced within 2 days at pH values of 3.0 and 4.0, but not 5.0, 5.5, or 6.0. ATP levels were significantly reduced at pH 30., but not at the other pHs tested. After 18 days microbial activity significantly correlated with weight loss, nitrogen content, and C/N ratios of the litter but did not correlate with ATP levels. Fungi present at ambient pH did not become dominant at pH below 5.5, diatoms were absent below pH 4.0, and bacterial numbers and extracellular slime were reduced at pH 4.0 and below. It was concluded that if the pH of the water from this slightly buffered lake were sufficiently reduced, rates of litter decomposition whould be significantly reduced. (Baker-FRC)
W82-06737

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,
Univerity of West Florida, Pensacola. Dept. of Biology.
M. A. Hood, and G. E. Ness.
Applied and Environmental Microbiology, Vol 43, No 3, p 578-584, March, 1982. 9 Fig, 20 Ref.

Descriptors: *Estuaries, *Bacteria, *Escherichia coli, Estuarine environment, Coastal waters, Marine waters, *Vibrio cholerae, Coliforms, *Florida, Apalachicola Bay.

The survival of strains of Vibrio cholerae in estuarine waters was studied and compared to that Escherichia coli. Water and sediment samples were collected from Apalachicola Bay, Florida. The enviromnetal V. cholerae serotype 01 strain (WF/1) survived well in estuarine waters and sediments. The survival of WF/1 was examined in sediments and waters collected from two different sites. One site had a lower mean salinity than the site at which the organism was originally found. Although the salinities of the waters at the sites were 6 and 15% there was no significan difference in the survival of the organism. The survival of WF/1 varied with the time of the year when samples were taken. The temperature at which the survival chambers were incubated had a significant effect on organism survival. Comparison of different V. Cholerae strains revealed no significant differences in the survival of serotype 01 and non-01 isolates in sterile or nonsterile sediments or waters. E. coli ATCC 25922 did not survive well in estuarine waters and could not be recovered by plating or most probable number procedures after 7 days in nonsterile water and 14 days in sterile water. These findings may explain the recent observations that V. cholerae levels do not correlate well with fecal coliform concentrations in estuarine waters. Futhermore, the results add increasing evidence to support the theory that V. cholerae is an autochthonous bacterium in estuaries. (Baker-FRC)
W82-06742

INTERMEDIARY METABOLISM OF ORGANIC MATTER IN THE SEDIMENTS OF A EUTROPHIC LAKE,
Michigan State Univ., Hickory Corners, W. K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Applied and Environmental Microbilogy, Vol 43, No 3, p 552-560, March, 1982. 4 Fig, 5 Tab, 37 Ref.

Descriptors: *Lake sediments, *Decomposing organic matter, Organic matter, Decomposition, *Metabolism, *Eutrophication, Fatty acids, Methanogenesis, Fermentation, Anaerobic conditions, Sedments, Sedimentation, *Michigan, Wintergreen Lake.

The rates of production and fates of the fermentation intermediates were investigated in the profundal sediments of a eutrophic lake (Wintergreen Lake, Michigan) in order to identify the central intermediates in carbon metabolism. The relative importances of sulfate reduction and methanogenesis in controlling the turnover of fermentation intermediates were also examined. C-14 labeled fatty acids were directly injected into sediment subcores for turnover rate measurements. The highest rates of acetate turnover were in surface sediments of up to 2 cm depth. Methane was the dominant product of acetate metabolism at all depths. Simultaneous measurements of acetate, propionate, and lactate turnover in surface sediments gave turnover rates of 159, 20, and 3 microM/hr respectively. Inhibition of methanogenesis with chloroform resulted in an immediate accumulation of volatile fatty acids and hydrogen. Hydrogen inhibited the metabolism of C3-C5 volatile fatty acids. The rates of fatty acid production were estimated from the rates of fatty acid accumulation in the presence of chloroform or hydrogen. The mean molar rates of production were acetate, 82%; propionate, 13%; butyrates, 2%; and valerates, 3%. A working model for carbon and electron flow is presented which illustrates that fermentation and methanongenesis are the predominant steps in carbon flow and that there is a close interaction between fermentative bacteria, acetogenic hydrogen-producing bacteria, and methanogens. (Baker-FRC)
W82-06745

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,
Washington Univ., Seattle. Dept. of Microbiology and Immunology.
J. T. Staley, L. G. Lehmicke, F. E. Palmer, R. W. Peet, and R. C. Wissmar.
Applied and Environmental Microbiology, Vol 43, No 3, p 664-670, March, 1982. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Volcanoes, *Lakes, Subalpine zone, Climatic zones, *Mt St Helens, Washington, Coliforms, *Bacteria, Disasters, Bacterial analysis, Limnology.

Changes in the bacterial communities in lakes near Mt. St. Helens were studied during the summer of 1980 and the spring and summer of 1981. Four subalpine lakes that lie immediately outside the blast zone were designated as controls. All other lakes studied were in the scorched, timber blow down, debris avalanche area within the blast zone. Two new lakes (Coldwater and Castle) were formed by the debris avalanche damming tributaries of the North Fork of the Toutle River. Lakes that were severely affected by the eruption and debris avalanches had higher microscopic bacterial counts than controls. All lakes affected by the eruption yielded higher viable numbers of heterotrophic bacteria than controls. Ryan and Castle lakes, with the highest microscopic counts initially, had the lowest viable counts of all of the blast zone lakes. Vertical profiles of Sprit and Castle Lakes indicated that the bacterial numbers were quite uniform from surface to bottom. Total or fecal coliform bacteria were not found in the control lakes. In contrast, all of the blast zone lakes had detectable total coliform bacteria, and some had fecal coliform bacteria after the eruption. Coliform bacteria were more numerous than expected in blast zone lakes, but they were not the most abundant bacteria in any of the lakes. It was concluded that blast zone lakes were significantly affected by the eruption. (Baker-FRC)
W82-06746

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,
University of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06747

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,
Tokyo Univ. (Japan). Ocean Research Inst.
T. Nishio, I. Koike, and A. Hattori.
Applied and Environmental Microbiology, Vol 43, No 3, p 648-653, March, 1982. 5 Fig, 2 Tab, 12 Ref.

Descriptors: Estuarine environments, *Denitrification, *Nitrogen, *Oxygen, Coastal waters, Estuaries, Marine waters, Tokyo Bay, Bays, Tama Estuary, Odawa Bay, *Japan, *Nitrates, Bacteria, *Sediments, Sedimentation, Microorganisms.

Denitrification rates were examined in an experimental sediment-water system in which filtered seawater containing N-15-labeled nitrate flowed at a constant rate over undisturbed coastal and estuarine sediments. The rates of oxygen and nitrate consumption were determined simultaneously and were compared with the rate of denitrification. Seawater and sediment samples were collected at Tama Estuary, Odawa Bay and Tokyo Bay. The concentrations of nitrate plus nitrite in the overlying waters ranged from 17.4 to 114 microM, but those in the sedimentary pore waters were very low. The concentrations of dissolved oxygen and nitrate changed similarly over time. The concentrations of nitrite remained about the same throughout the study. Steady levels of dissolved oxygen and nitrate in the effluent were achieved

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within 3 hr, and these levels were maintained for 20 to 30 hr. A later decline in dissolved oxygen and nitrate concentrations was attributed at least in part to the growth of microorganisms on the walls of the Plexiglas tubes and connecting tubes and on the bottom surfaces of the rubber stoppers. The oxygen and nitrate concentrations in the effluent actually increased when the inner surfaces of the rubber stoppers were cleaned with gauze and the connecting tubes replaced. The amounts of nitrogen evolved were found to increase initially, but after 10 hr from the onset of the study the concentration remained fairly constant. This indicates that most of the denitrification occurred near the surface of sediments, as bacterial nitrate consumption was fast, and that the concentration of evolved nitrogen in the sedimentary pore water near the sediment-water interface reached a steady level within 10 hr. (Baker-FRC)
W82-06748

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,
Freshwater Biological Association, Ambleside (England).
G. H. Hall.
Applied and Environmental Microbiology, Vol 43, No 3, p 542-547, March, 1982. 4 Fig, 2 Tab, 49 Ref.

Descriptors: *Lakes, *Nitrification, *Hypolimnion, Plankton, Metabolism, Thermal stratification, Stratification, Nitrogen, Biotransformation, Grasmere Lake, Ammonia, Nitrates, Mesotrophic lakes.

The chemical evidence for planktonic nitrification in the hypolimnion of lakes was investigated. The C-14 labeled carbon dioxide inhibitor method was tested for measuring rates of nitrification. Three distinct phases were noted in the change of dissolved inorganic nitrogen concentrations. An initial increase in ammonia concentration was followed by decreasing ammonia and increasing nitrate concentrations. The final phase was characterized by decreasing nitrate and increasing ammonia concentrations. The second phase was typical of the nitrification process. However, changes observed in inorganic nitrogen concentrations in the water column may not have been a result of in situ microbial activity, as production in and diffusion from sediments can affect the observed concentrations, particularly in the lower hypolimnion. Observations on nitrate concentration gradients between surface sediments and the water column and experiments using the nitrification inhibitor N-Serve indicated the in situ activity of chemolithotrophic nitrifying organisms. Nitrification rates were estimated throughout the period of stratification by using the N-Serve and C-14 labeled bicarbonate uptake method. Comparison of the field nitrate concentrations with the predicted nitrate concentrations from estimates of the nitrification rate indicated that the method underestimated the true rate of nitrification. (Baker-FRC)
W82-06749

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,
Wisconsin Univ., Eau Claire. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06751

EFFECTS OF POLYCHLORINATED BIPHENYLS AND ENVIRONMENTAL BIO-TRANSFORMATION PRODUCTS ON AQUATIC NITRIFICATION,
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, M. P. Shiaris, W. Beck, and S. Held.
Applied and Environmental Microbiology, Vol 43, No 4, p 949-952, April, 1982. 3 Fig, 25 Ref.

Descriptors: *Nitrification, *Polychlorinated biphenyls, Organic compounds, Chemical reactions, Water pollution effects, Microorganisms, Nitrogen, Oxidation.

The impact of polychlorinated biphenyls on autotrophic nitrification in freshwater environments was investigated. Possible biotransformation products were examined to determine whether they represent a potential nitrification perturbation. Center Hill Reservoir, a relatively pristine aquatic habitat, and Fort Loudon Reservoir, a contaminated nutrient-rich habitat, were used for studies on the effect of PCBs on nitrification. The effects observed were unclear. PCBs at concentrations greater than 10 micrograms/liter inhibited nitrification, principally ammonium oxidation, in one of the two natural reservoir environments. However, this inhibition could not be reproduced in pure high-cell-density cultures or in previously contaminated reservoir waters. The PCB environmental biotransformation product p-chlorophenylglyoxylic acid and p-chloromandelic acid had no effect on nitrification. It is noted that the studies reported here employed acute dosing conditions which ranged to concentrations that exceeded both the solubility of Aroclor 1254 (120 micrograms/liter) and concentrations likely to be encountered in the environment. It appeared that the primary target of inhibition was located at the level of the ammonium-oxidizing microorganisms. However, transient high levels of NO2(-) may accumulate due to a lesser inhibition in NO2(-) oxidation, and elevated NO2(-) concentrations may serve to further inhibit NO2(-) oxidation. (Baker-FRC)
W82-06753

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,
Rostock Univ. (Germany, D.R.).
U. Schiewer, H. A. Al-Saadi, and H. A. Hameed.
Archiv fur Hydrobiologie, Vol 93, No 2, p 158-172, January, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Tidal effects, Shatt al-Arab, Estuaries, Basrah, *Iraq, Aquatic life, Nutrients, Rivers, Water pollution effects, Canals, Tides, Tidal currents, Wastewater disposal, Raw wastewater, Wastewater, *Diel rhythm.

A short distance below the confluence of the Euphrates and the Tigris, the Shatt al-Arab receives all the untreated sewate of Basrah, a town with more than half a million inhabitants. In addition to seasonal changes in water level, the whole stretch of the Shatt al-Arab is subject to tidal influences, with the mean fluctuation in water due to tidal influences being 1.7 meters. The effect of these tidal influences on the hydrography and production biology of the Shatt al-Arab and on one of the main canals in the town of Basrah was examined in order to draw conclusions regarding the dynamics of the overall system in the upper reaches of Shatt al-Arab. The study showed that there was little sign of diel rhythms in the Shatt al-Arab, while a tide-induced diel rhythm was evident in the canal. Phytoplankton productivity of the Shatt al-Arab was low in December. Nutrient content and phytoplankton productivity in the canal were high, mainly due to fecal sewage. A cyclotella meneghiniana bloom was present during the studies. According to these findings the east shore of the Shatt al-Arab can be described as a system lying between the oligotrophic and eutrophic states. Conditions in the Al-Khandak Canal, in contrast, are allotrophic. The tides have a double beneficial effect on the Canal in that they not only flush the sewage away during the ebb, but also mix the top and middle layers of the canal water with oxygen rich water during the flood. (Baker-FRC)
W82-06763

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,
Kumaun Univ., Nainital (India). Dept. of Zoology.
A. P. Sharma, S. Jaiswal, V. Negi, and M. C. Pant.
Archiv fur Hydrobiologie, Vol 93, No 2, p 173-174, January, 1982. 4 Fig, 11 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Lakes, *Ecology, Kumaun Himalaya, Himalayas, Nainital Lake, Khurpatal Lake, Bhimtal Lake, *India, Natural waters, Nutrients, Wastewater disposal, Water pollution sources, Altitude, Elevation, Species diversity.

Information on the phytoplankton community of three representative lakes in the Kumaun Himalaya region was sought by using various coefficients commonly employed by terrestrial ecologists. The lakes studied were Nainital, Bhimtal and Khurpatal; they are situated in an area with a radius of about 20 km, taking Nainital as the center. There are 24 open drains in the catchment of Nainital, carrying household refuse, garbage, silt and unmeasured amounts of sewage and other waste products into the lake. Bhimtal is characterized by only one perennial drain carrying only a small amount of waste products and no sewage. Khurpatal has no perennial drain, but runoff water enters along all hill slopes of the watershed. Waters of Nainital have frequent blooms and subsequent collapses of green and blue-green algae, while the algal population in Khurpatal was monopolized by dinoflagellates throughout the year. Bhimtal had a representative plankton assemblage composed of green algae, diatoms and dinoflagellates. The dominance of dinoflagellates in Khurpatal can be attributed to the low levels of phosphorus present. The communities were strongly heterogeneous even on a monthly basis. Beta-diversity was higher in Lakes Nainital and Khurpatal and lower in Bhimtal, indicating that the beta-values increased with the elevation of the lakes. The dominance in Nainital and Khurpatal was centered around a few taxa, while in Bhimtal the number of dominant species was large. Nainital had low equitability and high species richness. Bhimtal had intermediate equitability and richness, and Khurpatal was poorest in species and had low equitability. (Baker-FRC)
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),
A. deInfante.
Archiv fur Hydrobiologie, Vol 93, No 2, p 194-208, January, 1982. 10 Fig, 1 Tab, 30 Ref.

Descriptors: *Zooplankton, *Seasonal variations, *Population dynamics, Aquatic life, Lake Valencia, *Venezuela, Fish populations, Rotifers, Copepods, Cladocerans, Algae, Temperature effects, Nutrients.

Duplicate samples were taken at five sites at 2 meter vertical intervals every two weeks from Lake Valencia and subjected to analysis to determine annual variations in abundance of zooplankton in the lake. The lake is warm monomictic. Phytoplankton consists of about 100 species. Blue-green algae are dominant, followed by diatoms and green algae. Zooplankton include 36 rotifer, 8 copepod and 10 cladoceran species. Two annual periods of maximal abundance of zooplankton occur: December through January and March through May. Each of these times is associated with increases in nutrients and phytoplankton in the lake. Two annual periods of minimal abundance were noted in June and November. Annual variations of the most important Copepoda, Cladocera and Rotifera species were related to variations in food availability and predators in the lake. (Baker-FRC)
W82-06765

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,
Canada Centre for Inland Water, Burlington (Ontario).
D. Liu.
Water Research, Vol 16, No 6, p 957-961, June, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Sludge disposal, Water quality, Water pollution sources, Land disposal, Wastes disposal, Wastewater disposal, Microorganisms, Leaching, Infiltration, Percolation.

This study was intended to investigate the long term effect of farmland disposal of anaerobically digested chemical sewage sludge on the microbial quality of groundwater. Sludge application rates to the lysimeters were based on total Kjeldahl nitro-

gen loading and ranged from 0 to 1500 kg TKN/ha/yr. The successive application of sewage sludge to the lysimeters from 1973 through 1976 resulted in an accumulation of high concentrations of sludges on most lysimeters except the control ones. The chemical and microbiological parameters of the three digested sewage sludges were determined. The average chemical compositions suggested that they possessed low-grade fertilizing potential for crop growth provided potassium was supplemented. Coliform baceria were a very minor group throughout the study of the total heterotrophic bacterial populations in the anaerobically digested sludges. The movements of the sludge microorganisms were followed in loamy sand and silt loam soil systems after 1-4 years of land disposal. The soils apparently had an enormous capacity to retain all microorganisms, and consequently over 90% of the surviving heterotrophic bacteria were still detained in the top 30 cm layer of both soil systems. Mass balance calculations indicated that over 95-98% of the original heterotrophic bacteria in the sludges had perished during this period of time. About three times more bacterial biomass and leachate were lost from the coarser loamy sand than from the finer silt loam after sludge application. Microbiological contamination of groundwater by the practice of sludge farmland disposal seems unlikely to occur, provided that the groundwater table is not high and the soils are not excessively wet. (Baker-FRC)
W82-06767

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,
Calgary Univ., Alberta. Dept. of Biology.
L. L. Osborne, R. W. Davies, K. R. Dixon, and R. L. Moore.
Water Research, Vol 16, No 6, p 899-902, June, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Fish, *Sediments, Rivers, Sheep River, *Alberta, Canada, *Mutagenic activity, Salmonella, Benthos, Ames test, Chlorination, Effluent, Wastewater treatment, Pollutant identification.

The purpose of this study was to determine whether increased mutagenic activity in fish and benthic sediments was developing as a result of the discharge of chlorinated sewage effluent into a section of the Sheep River, Alberta. The Ames Salmonella/ mammalian microsome assay was used to assay the mutagenic activity of the fish and sediment samples. Collection sites for the benthic sediments were from areas inside and outside of the chlorinated sewage plume. There was no indication of increased mutagenic activity in the sediments collected from within the chlorinated sewage plume, indicating that the mutagenic activity of the macroinvertebrates was not due to direct accumulation from the benthic sediment food source. One trend noted in the TA 100 results was an inverse relationship between sample volume and the number of colonies. This trend may have been a result of DMFA toxicity to bacteria, which could mask or comlicated the interpretation of dose mutagenic relationships. A significant increase in the mutagenic activity was observed in the fish samples collected from the chlorinated sewage plume. (Baker-FRC)
W82-06770

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06774

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,
West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.
D. A. Cincotta, J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 18, No 3, p 437-450, June, 1982. 14 Fig, 4 Tab, 52 Ref.

Descriptors: *Thermal water, *Fish populations, Heated water, Pulp and paper industry, Water pollution effects, Industrial wastes, *Thermal pollution, Thermal stress, *West Virginia, Codorus Creek.

Literature relating to 11 designated temperature criteria for six representative important species (RIS) was reviewed. The applicability of the Environmental Protection Agency (USEPA) water quality criteria to a nonutility thermal dishcarge was also reviewed, and an evaluation was made of the importance of behavioral data in thermal impact assessments. It was found that by applying only USEPA suggested criteria a complete and satisfactory evaluation was not obtained. Temperature behavior data, specifically preference and avoidance information, coupled with field sapling was needed to properly assess the effects of the thermal effluent. An application of this technique indicated that the thermal discharge of a paper company such as the one considered should have mnimimal effects on the fish community of the stream, Codorus Creek, which receives the thermal effluent from the plant. (Baker-FRC)
W82-06777

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, R. A. Jones, and F. Y. Saleh.
Journal of Environmental Science and Health, Part B, Vol 17, No 4, p 409-437, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Pesticide residues, *Water quality standards, *Pesticides, *Water pollution effects, Agricultural chemicals, Water pollution sources, *Sediments, Bottom sediments, Rivers, Ponds, Toxicity, Bioassays, Bioaccumulation, Aquatic life, Standards, *Egypt, Regulations, Environmental effects, Particulate matter.

A recommended approach for establishing pesticide water quality standards and use regulations in Egypt is presented. The approach involves collecting and critically evaluating existing residue data; developing a monitoring program to fill data gaps; development of Egyptian water quality criteria and standards and organism tolerance levels; and comparing the critical concentration of pesticides developed for Egypt to existing concentrations. If excessive concentrations are found, then site-specific studies should be conducted to evaluate the role of soil pesticide residues in causing the excessive concentrations. Emphasis is placed in this approach on the importance of aquatic particulate matter in influencing the hazard that a specific pesticide represents to a particular beneficial use of a given aquatic system. The principles of hazard assessment are reviewed, including aquatic toxicity through organism toxicity and bioaccumulation; environmental fate; tiered testing; and the implications for pesticide use and labeling restrictions. The significance of sediments in hazard assessment is discussed, with emphasis on the presence of particulates, pesticide-particulate matter interactions, chlorinated hydrocarbon release from sediments, the effect of concentration on release from sediments, the implications of sediment concentrations of pesticides for use regulations, various bioassay techniques to determine contamination levels, the bioaccumulation of pesticides by benthic and epibethic organisms, and the use of deterministic models of pesticide behavior to determine sediment contamination probabilities. Cost effectiveness of specific hazard assessment vs. worst case regulations governing pesticide use is also considered. (Baker-FRC)
W82-06789

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W82-06790

ACID PRECIPITATION, A REVIEW,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, S. H. Kunkle, and D. R. DeWalle,.
Journal of Soil and Water Conservation, Vol 37, No 3, p 143-148, May/June, 1982. 3 Fig, 44 Ref.

Descriptors: *Acid precipitation, *Reviews, *Literature reviews, Soil properties, Acidity, Rainfall, Aquatic plants, Fish populations, Water pollution effects, Water pollution sources, Nonpoint pollution sources, Snowmelt.

The pH of rainfall under normal conditions is about 5.6. The measured pH of rain falling in the northeastern United States during the last decade averaged between 4.0 and 4.6, depending on location. The hydrogen ion concentration in precipitation today is 6 to 40 times higher than the theoretical value that would occur at the nonpolluted pH level of 5.6. Some researchers have concluded that the principal ause of higher precipitation acidity is increased fossil fuel combustion and use of taller smokestacks. A major concern is the effect of acid precipitation on aquatic ecosystems, and particularly on fish populations.Areas with poorly buffered streams and areas with crystalline or metamorphic bedrock having shallow, acid soils with a low buffering capacity are especially sensitive to acid precipitation. In some locations the snowpack appears to store the acid, releasing it during sudden thaws, and thus rapidly depressing stream pH. The potential effect of acid precipitation on trees and other vegetation is of concern as well. Long term effects of acid precipitation on the growth rates of vegetation and soil fertility are hard to ascertain and will demand long term research. Some experts in the field, however, feel that the current concern represents overreaction to the issue. (Baker-FRC)
W82-06794

FRESHWATER MACROINVERTEBRATES,
National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
M. A. Quigley.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 868-877, June, 1982. 183 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Environmental effects, *Reviews, Sediments, Macroinvertebrates, Water pollution effects, Lakes, Streams, Species composition, Indicators, Bioindicators, Organic compounds, Streamflow, Temperature effects, Turbidity, Floods, Drought, Logging, Recreation, Urban development, Thermal pollution, Aquatic habitats, Habitats, Predation, Benthic fauna, Seasonal variation, Productivity, Sampling.

The effects of pollution on freshwater macroinvertebrates were reviewed. Several books and two new journals appeared in 1981. A biotic index, a biological water quality index, an index focused on interaction of lake sediments with toxic substances, a modified Hill's ratio, and use of oligochaetes as indicator species were proposed. Case studies of pollution were described: experimental acidification, urban storm water runoff, road salt, synthetic crude oil, copper, zinc, tannery effluent, and ash. Macroinvertebrates were also affected by alteration of the physical environment of lakes and streams (temperature, stream flow and depth, turbidity, dissolved oxygen concentration, and water level fluctuations) produced by channelization, sedimentation, flash floods, drought, logging, recreational activities, thermal discharge, and urban development. Species distribution was also a function of predation, substrate, vegetation type, flow conditions, available food, water quality, and season. Production was discussed in relation to environmental factors, including trophic status. Invertebrate penetration of the sediments produced significant sediment mixing and phosphorus release. Many invertebrate sampling techniques and methods of statistical analysis were developed. (Cassar-FRC)
W82-06797

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EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Research Lab. Duluth, MN.
R. L. Spehar, G. M. Christensen, C. Curtis, A. E. Lemke, and T. J. Norberg.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 877-922, June, 1982. 1 Tab, 353 Ref.

Descriptors: *Literature reviews, *Fish, *Toxicity, *Pesticides, *Reviews, *Water pollution effects, Fate of pollutants, Accumulation, Bioaccumulation, Water quality, Dissolved oxygen, Oxygen, Nitrogen, Ammonia, Acidic water, Hydrogen ion concentration, Hydrocarbons, Insecticides, Herbicides, Piscicides, Metals, Heavy metals, Industrial wastes, Effluents, Nitrites, Surfactants, Organic compounds, Chlorine, Wastewater pollution, Pulp and paper industry, Radiation, Turbidity.

A review of recent studies of effects of pollution on fresh water fish features a table summarizing the acute and chronic toxicity of about 250 inorganic and organic pollutants. The substances are listed alphabetically, followed by the fish species, Lc50 values, type of exposure, water temperature, and test conditions. The materials include insecticides, herbicides, piscicides, anesthetics, inorganic compounds and metals, organic compounds, industrial and municipal effluents, chlorine, and pulp and paper effluents. The review also describes 28 reviews and symposia on the subject. The effects of water quality (excesses and deficiencies of dissolved gases such as nitrogen, oxygen, ammonia, and HCN) and pH and acid stress are discussed. The effects of X-irradiation, nuclear waste, chronic turbidity, and reservoir discharge are also mentioned. (Cassar-FRC)
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
A. L. Buikema, Jr., E. F. Benfield, and B. R. Niederlehner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 862-868, June 1982. 83 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Reviews, *Water pollution effects, Aquatic animals, Aquatic insects, Insects, Heavy metals, Metals, Cladocerans, Zooplankton, Leachates, Surfactants, Shale oil, Amphipods, Isopods, Decapods, Mollusks, Worms, Protozoa, Pesticides, Insecticides, Organic compounds, Industrial wastes.

Recent work on the effects of pollution on invertebrates included several reviews (acid precipitation, powerplant effluents, and hazard assessment). New test methods for pesticide residues, chlorine, petroleum products, and synfuel components were described. Effects of toxic materials were discussed according to the following divisions: invertebrate communities, cladocerans, other zooplankters, amphipods, isopods, decapods, aquatic insects, mollusks, worms, and protozoa. Among the many pollutants studied were metals (Cd, Cu, Cr, Zn, and Sr), solvents, pesticides, insect growth regulators, bird control chemicals, acridine, quinoline, vinylidene chloride, coal process conversion products, phenanthrene, naphthalene, oil shale wastewater, boric acid, surfactants, chlorine, dye wastes, municipal wastewater sludges, textile mill effluents, paper mill effluents, fly ash, phenolic compounds, and thermal discharges. (Cassar-FRC)
W82-06804

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
D. J. Reish, G. G. Geesey, F. G. Wilkes, P. S. Oshida, and A. J. Mearns.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 786-812, June, 1982. 6 Tab, 392 Ref.

Descriptors: *Literature reviews, *Marine environment, *Water pollution effects, *Reviews, *Estuarine environment, Estuaries, *Pesticides, Microbiological studies, Human diseases, Waste disposal, Oil pollution, Sediments.

Recent research in the field of marine and estuaring pollution is cited in this literature review. Major areas considered included pesticides, acute effects, sublethal effects, fate, bioaccumulation, microbiology, and residues; microbiology; diseases and abnormalities; drilling fluids and muds; dredge and solids disposal; surveys; residues and related topics; oil pollution, residue analysis, residues in water and sediment, residue fate and weathering, residues in biota, dispersants, microbes, bioaccumulation, field studies, toxicity and sublethal effects and complex effluents and environments. (Baker-FRC)
W82-06808

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
J. B. Cravens.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 812-829, June, 1982. 9 Tab, 206 Ref.

Descriptors: *Literature reviews, *Thermal pollution, *Reviews, Thermal water, *Heated water, Powerplants, Thermal powerplants, *Thermal stress, Fish populations, Aquatic life, Water temperature, Temperature effects, Thermal stress, Model studies, Mathematical models, Mathematical studies, Reservoirs, Lakes, Rivers, Mediterranean Sea, Estuaries, Great Lakes, Water pollution effects.

Recent research in the area of thermal effects on water pollution are cited in this literature review. Various reviews and models were considered, including mathematical models of the temperature and time from fertilization to 50% hatch for five species of salmonid fishes, the relationship between the maximum daily food consumption and water temperature for two species, the mathematicalthermodynamic analysis of the anomalies of water, and mathematical models of the behavior and activity of thermal plumes formed when power plants discharge heated water. Site studies were performed at cooling lakes and reservoirs in various streams and rivers, at the Great Lakes, in the Mediterranean, and in various estuarine and marine systems regarding the effects of thermal plumes on aquatic life. The effects of thermal plumes on growth and reproduction of various forms of aquatic life were considered along with these effects on higher plants. Thermal effects on the reproductive cycles of adult tench Tinca tinca were presented in several studies. Thermal tolerance and temperature preference ranges were investigated fo numerous fishes and aquatic invertebrates. The interaction of temperature and other stresses was studied in aquatic flora and fauna. Biochemical reaction studies were also performed using the hermaeid ascoglossan slug Costasiella lilianae. The effect of water temperature and dissolved oxygen on the rate of biodegradation of nitrilotriacetate from samples collected from the Rur River in Belgium was studies. (Baker-FRC)
W82-06809

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 778-784, June, 1982. 3 Tab, 72 Ref.

Descriptors: *Literature reviews, *Dissolved oxygen, Reservoirs, Streams, *Reviews, Water quality, Environmental effects, Aquatic life, Fish populations, Aquatic plants Model studies, *Destratification, *aeration, Stratification.

Current literature in the field of dissolved oxygen (DO) in streams and reservoirs is reviewed. Efforts make in the area of stream standards have included a system of effluent taxes to achieve water quality standards, the concept of transferable discharge permits for BOD control, and production theory and marginal cost analyses to find the optimal combination of treatment for all wastewaters generated within an urban area. Water quality in streams and reservoirs was examined with respect to the occurrence and distribution of dissolved oxygen and organic compounds in mountain streams, the environmental impacts associated with pumped-storage hydroelectric development, and the economic value of DO levels to fishery tailwater. Aquatic effects were investigated as a function of DO, along with the effects of hypolimnetic discharges and trace minerals. Conference proceedings contained papers dealing with surface water impoundments, stormwater impact on reservoirs, and urban storm runoff. Water quality models were developed to simulate hydraulic behavior, DO, and BOD of a river network, multiple linear correlations for computing DO concentrations as a function of stream distance, differential inequality techniques to determine the upper and lower envelope of DO concentrations, river models for DO and BOD reductions to a simple function of downstream distance, and a review of the receiving-water impacts subprogram. Oxygen demand and response to waste loads were considered, along with papers dealing with reaeration and destratification as well as gas transfer and measurement. (Baker-FRC)
W82-06811

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
C. B. Murphy, Jr., and S. J. Spiegel.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 849-854, June, 1982. 84 Ref.

Descriptors: *Literature reviews, *Bioaccululation, *Heavy metals, *Reviews, Cadmium, Copper, Mercury, Lead, Zinc, Manganese, Toxicity, Fish, Aquatic plants, Aquatic life, Diatoms, Nickel, Vanadium, Iron, Mussels, Estuaries.

Current research in the field of bioaccumulation and toxicity of heavy metals and related trace elements is cited in this literature review. Specific metals investigated in various aquatic environments inluded mercury in the muscle tissue of fish from northern lakes; trace elements in tropical marine fish from Bougainville Island, Papua-New Guinea: the occurrence and distribution of zinc, copper, iron, manganese and cadmium in the water column and different parts of Tikpia fish from Lake Mariut, Egypt; and the elemental composition of aquatic plants from the Okefenokee Swamp in Georgia. Bioconcentration research touched on the copper accululation and tissue injury in the gills of the sabellid polychaete Eudistylia vancouveri, on the distribution of cadmium within captive crabs, on the concentration of V, Mn, Ni, Cu, Zn, and Cd in bay mussels, on the relation between mercury concentration and size in the mako shark Isurus oxyrhinchus, on cadmium concentrations inducing morphological changes in the diatom Tabellaria flocculosa, and on concentrations of elements in a marine food chain. Toxicity studies were conducted for cadmium, copper, other metals, synergistic and combined elements. Research was also conducted on the detoxification of heavy metals and on applications of heavy metal toxicity. (Baker-FRC)
W82-06812

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,
Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
J. K. Liou, and G. C. Van Eybergen.
Water Research, Vol 16, No 6, p 765-773, June, 1982. 13 Fig, 2 Tab, 20 Ref.

Descriptors: *Algal growth, *Model studies, Light penetration, *Light intensity, Lighting, Drinking water, Water quality.

The importance of the consideration of light adaptation and inhibition for the models for algal growth is evaluated. A model is proposed to de-

scribe the photosynthesis-light relationship, including adaptation and inhibition. By comparing time constants it was made clear that one has to seriously consider taking adaptation into account. With high measuring frequencies and especially long vertical circulation times (large mixing depths) it should be realized that this process can be important. In field situations inhibitions will not play an important role. However, for laboratory situations inhibition can have a considerable effect on the photosynthetic production. The model as presented compared with experimental results given in the literature. The results of comparison seemed satisfactory, but further experimental work is needed. (Baker-FRC)
W82-06827

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06829

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
York Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-06832

METHANE FLUX IN THE GREAT DISMAL SWAMP,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2H.
W82-06840

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,
Hawaii Inst. of Marine Biology, Honolulu.
For primary bibliographic entry see Field 5G.
W82-06846

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson, J. Turner, and J. M. Kelly.
Water Resources Research, Vol 18, No 3, p 449-461, June, 1982. 1 Fig, 4 Tab, 123 Ref.

Descriptors: *Acid rain, *Reviews, Acidity, Air pollution, Fallout, Rainfall, *Forest management, Leaching, *Litter, Organic matter, *Decomposing organic matter, Adsorption, Soil properties, *Nutrient cycling.

A review was conducted of actual and potential effects of acid rain on forest nutrient status, using the conceptual nutrient cycling model as a guideline. The effects of acid rain on the processes of gaseous output, root turnover, leaching, uptake, litterfall, streamflow, crownwash, runoff, redistribution, and decomposition are considered, as well as the effects of all these processes on the composition of water entering and leaving the forest ecosystem. Acid rain appears to be a global phenomenon, with areas downwind from major centers of fossil fuel combustion being especially affected. Changes in precipitation quality are well documented in the northeastern US, Norway, Sweden, and northern Germany, along with other locations in both the northern and southern hemispheres. Forests growing in areas currently experiencing elevated rainfall acidity are generally on sites which are relatively infertile for one reason or another. The input by hydrogen ions along with other elements in rainfall is further compounded by washoff of materials deposited on plant surfaces due to the atmospheric stripping action of forest canopy. The implications of acid rainfall must be assessed on a total ecosystem basis, and the specific processes isolated and quantified. It is noted that the impacts on a given site can be positive, negative, or both, in the sense of counteracting influences. Consequently the conduct of management practices will need to be keyed to the particular situation to treat certain inputs as assets while minimizing or reducing the impacts of detrimental substances. (Baker-FRC)
W82-06860

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,
California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5D.
W82-06870

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,
Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5B.
W82-06871

PHYSICAL PROCESS AND EUTROPHICATION,
Windsor Univ. (Ontario). Dept. of Biology.
G. D. Haffner, D. J. Poulton, and B. Kohli.
Water Resources Bulletin, Vol 18, No 3, p 457-464, June, 1982. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Harbors, *Eutrophication, Retention, Physical properties, Retention time, Phytoplankton, Lakes, Nearshore processes, Oscillations, Nutrients, Currents, *Lake Ontario, Great Lakes.

Two considerably different physical regimes of culturally enriched water bodies were compared. Biological responses to physical-chemical processes were examined in Toronto and Hamilton Harbors of Lake Ontario. Nutrient loadings of both harbors are large and of similar magnitudes, yet the trophic conditions are different. Lake oscillations apparently determined the flushing rates and environmental stability of the harbors. Low residence times (less than 10 days) resulted in homogeneous chemical conditions in Toronto Harbor, preventing the establishment of large phytoplankton crops. The longer retention time found in Hamilton Harbor permitted larger phytoplankton crops to become established. A critical retention time probably exists where nutrient input events persist for a sufficient period of time for the algal community to adapt to and exploit the environmental conditions of nearshore areas. These findings suggest that steady state theory must be applied carefully to the Great Lakes Nearshore zone. Models using steady state conditions to predict response of the system to nutrient controls should be viewed with great caution. The effects of physical processes on eutrophication must be considered. It is apparent that in neither harbor examined would the traditional expectations of nutrient control programs be realized due to the physical processes inherent to nearshore zones of large lakes. (Baker-FRC)
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,
Lund Univ. (Sweden). Inst. of Limnology.
G. Cronberg.
Archiv fur Hydrobiologie, Supplement 60, No 4, p 500-507, February, 1982. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Lake sediments, *Algae, Algal growth, Sediments, Lakes, Eutrophication, Nutrients, Oligotrophic lakes, Trophic level, Indicators, Bioindicators, *Sweden, Lake Vaxjosjon, Wastewater, disposal, Industrial wastes.

Lake Vaxjosjon is situated in the town of Vaxjo, south central Sweden, downstream from the restored Lake Trummen. The number and species of Pediastrum and Scenedesmus present in the lake were studied in a sediment core covering the period 1200 to 1970 A.D.. In recent times the lake was utilized as a recipient for sewage and industrial waste water from the town. The pollution was maintained at a high level from 1880-1930, when diversion of sewage started. During the worst pollution period a black anaerobic gyttja developed. The overall study demonstrated that the occurrence of Pediastrum and Scenedesmus species is of a complex nature, increasing in number when the nutrient concentration increases, changing in species composition in connection with eutrophication or oligotrophication processes, and developing (Pediastrum) in dependence on the macrophyte vegetation. Eutrophication first stimulates the macrophytes, and then both eutrophication and this macrophyte substrate act together to stimulate an increase in chlorococcal density. The Pediastrum species can be used as indicators of lake trophic status and history. (Baker-FRC)
W82-06878

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,
Academy of Natural Sciences of Philaelphia, PA.
J. W. Sherman, and R. Patrick.
Archiv fur Hydrobiologie, Vol 92, No 2, p 199-221, September, 1981. 9 Fig, 11 Ref.

Descriptors: *Paleolimnology, *Radioactive dating, *Cores, *Diatoms, Lakes, Limnology, Morphology, Aquatic life, Nutrients, Taxonomy, Stratigraphy, Lake Huleh, *Israel, Population dynamics, Oligotrophy, Mesotrophy.

The diatom stratigraphy of a 54-meter core taken from Lake Huleh, Israel was examined. The analysis of 500 specimen counts from each of 43 samples studied in this core indicated various historical changes in the condition of the water in the lake over the past 32,000 years. There is evidence that considerable reworking of sediments has occurred in certain horizons of the core, as evidenced by a high proportion of broken valves. In the early horizons of the profile the lake was shallow and somewhat swampy, with aquatic plants being fairly common. Toward the end of this period the lake deepened, and a well-formed deep lake existed for a period of time. During this deep stage the flora decreased greatly as the lake moved into a time of somewhat shallower, warmer and more eutrophic conditions. Later a swamplike condition occurred again in the lake, but there was still some open water areas that supported a plankton flora. The diatoms indicated that calcium was richer in this period than others and that the lake was somewhat warmer. Oligotrophic to mesotrophic conditions existed through most of the horizons except for one period when the nutrient levels may have been higher. (Baker-FRC)
W82-06880

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,
Pittsburgh Univ., PA. Dept. of Microbiology.
R. B. Yee, and R. M. Wadowsky.
Applied and Environmental Microbiology, Vol 43, No 6, p 1330-1334, June, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Bacteria, Plumbing, *Heated water, Hospitals, Legionella pneumophila, Incubation, Cooling water, Fate of pollutants, Public health, Human diseases.

Legionella pneumophila, obtained from a hospital shower head and from tap water in a surgical intensive care unit in another hospital, multiplied in unsterilized tap water at 25, 37, and 37 C for the length of the 35 day experiment. At 42 C L. pneumophila in the shower head sample began to die off after 17 days, but those in the intensive care unit samples continued to multiply for 35 days. Non-L. pneumophila bacteria increased in number for 2 days at 25, 32, and 37 C, then remained relatively constant for 35 days. At 42 and 45 C the shower head non-L. pneumophila bacteria decreased over 2 days to 100 CFU or less per ml.The intensive care unit non-L. pneumophila bacteria at 45 C incubation decreased to zero by the 14th day; at 42 C they multiplied as at the lower temperatures. These differences were caused by the different bacterial populations from the two sources. L.

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pneumophila taken from the bottom of a hot water tank also multiplied when cultured at 37 C. These results indicate that L. pneumophila may multiply in warm water environments such as hot water plumbing fixtures, hot water tanks, and cooling towers. (Cassar-FRC)
W82-06881

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,
Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
Z. H. Hammad, and H. A. Dirar.
Applied and Environmental Microbiology, Vol 43, No 6, p 1238-1243, June, 1982. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Bacteria, *Water quality, *Drinking water, Microbiological studies, Khartoum, *Sudan, Water supply, Coliforms, Zeers, Sebeel water, Developing countries, Pollutant identification, Fate of pollutants, Seasonal variation, Public health.

Sebeels are watering stands, consisting of 1 or more 30-40 liter baked clay jars (zeers), which provide cool drinking water throughout Khartoum and other communities in the Sudan. A microbiological examination of sebeel water (51 samples from streets, 15 from mosques, 10 from homes, and 7 from schools) showed that coliforms, fecal coliforms, and fecal streptococci were present in 100%, 69.88% and 91.56% of the samples, respectively. Predominant bacterial genera were Staphylococcus, Aerococcus, Micrococcus, Streptococcus, Bacillus, Listeria, Lactobacillus, and Arthrobacter. Colony counts were on the order of 100,000 cells per ml and were higher in school and street samples than in mosque and home samples. However, counts of coliforms were much higher for home sebeels than for the other types, probably a result of children's poor hygiene habits. There was no relationship between total colony count and fecal contamination. Total colony counts did not vary with the season, but total coliforms and fecal bacterial counts were much higher in summer than in winter, due to increased human use and increased bacterial regrowth in the warmer water. Likewise, fecal coliforms counts were much higher during dust storms than when dust was not blowing. Three types of zeer construction were evaluated with respect to water quality. After a month there was no fecal contamination in a zeer fitted with a faucet and firmly fitted lid. Within 2 days the other two types of zeers (movable lid with no faucet and movable lid with faucet) were contaminated. (Cassar-FRC)
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
For primary bibliographic entry see Field 5A.
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,
Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06885

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W82-06887

COMPARATIVE ASPECTS OF SULFUR MINERALIZATION IN SEDIMENTS OF A EUTROPHIC LAKE BASIN,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. M. King, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1406-1412, June, 1982. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Sulfur cycle, *Mineralization, Sediments, Sulfates, Sulfides, Organic sulfur compounds, *Lake sediments, Eutrophic lakes, Wintergreen Lake, *Michigan, Proteins.

Mineralization of organic sulfur compounds in the surface sediments of eutrophic Lake Wintergreen, Michigan, was estimated from a mass balance budget of S inputs and sediment S concentrations. Net mineralization was < 50% complete. Total S mineralization was 45% complete; ester sulfate S, 42% complete; and protein S, 75% complete. Therefore organic S accumulates in the sediment. Organic S comprosed > 80% of the total S in the sediment. Of the organic S fraction protein S was < 20%; ester sulfate, 44%; and nonprotein carbon bonded S (sulfolipids, vitamins, etc), 36%. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction rates averaged 7 nmol per sq m per day, 19-fold greater than net rates or organic S mineralization and 65-fold greater than sulfate ester hydrolysis, on an annual basis. (Cassar-FRC)
W82-06888

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and D. G. Redalje.
Marine Environmental Research, Vol 6, No 4 p 265-279, 1982. 4 Fig, 4 Tab, 39 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, *Kaneohe Bay, Hawaii, Diversion, Nutrient cycling, Phytoplankton, Nitrogen, Phosphorus, Benthos, Biomass, Water pollution effects, Growth rates, Subtropical regions, Bays, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Corals, Reefs.

Dissolved organic nitrogen and dissolved organic phosphorus concentrations in the water column were much higher than expected after diversion of secondary treated sewage from Kaneohe Bay, Hawaii, to the ocean. This was caused by decomposition of 400 tons of benthic organisms during the first year after diversion. Nitrogen was the limiting nutrient before and after diversion. Internal nutrient cycling accounted for 70-90% of the phytoplankton nutrient uptake. The biomass and growth rate of the phytoplankton declined after sewage diversion, from 37% to 28% of the maximum growth rate of 1.5 fold per day. The adverse effects of the sewage discharge on the coral community were mainly caused by increases in competing benthic macrophytes and elevated plankton concentrations, which attenuated light and stimulated growth of filter feeders. Although the inorganic nutrient levels returned to presewage levels within a year after diversion, the benthic community had not yet reached an equilibrium. (Cassar-FRC)
W82-06892

EFFECTS OF MACROALGAL MATS ON THE ECOLOGY OF INTERTIDAL,
Southern Water Authority, Otterbourne (England).
P. G. Soulsby, D. Lowthion, and M. Houston.
Marine Pollution Bulletin, Vol 13, No 5, p 162-166, May, 1982. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Invertebrates, *Algae, *Intertidal areas, Mud flats, Biomass, Water pollution effects, Langstone Harbor, *England, Species diversity, Aquatic habitats, Polychaetes, Snails, Birds.

The biomass and distribution of the invertebrate fauna in intertidal mudflats, covered with algae and unaffected by algae, were sampled on several occasions in 1977-78 at several sites in Langstone Harbor, south England. This study was part of investigations on the effects of discharging sewage effluents into the harbor. Algal-covered mud had higher invertebrate biomass than uncovered mud. Mean total invertebrate biomass values in autumn samples were 40-42 g per sq m dry weight in muds with > 75% algal mat cover and 12-14 g per sq m dry weight in muds with < 25% algal mat cover. Invertebrate biomasses under algal mats were lowest in January and highest in early fall. The dominant invertebrate was a snail, Hydrobia ulvae. The Shannon-Werner species diversity index showed very little difference between sites, but a log normal plot showed slight stress in the high-algal cover communities. The opportunistic polychaete, Streblospio shrubsoli, was significantly decreased in number at the high algal cover sites. The effects of algal mat cover on the aquatic bird population were discussed, using data from previous studies. It was concluded that algal mat, although perhaps undesirable, would have little effect on the bird population. (Cassar-FRC)
W82-06893

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),
University Coll. of Wales, Aberystwyth. Dept. of Zoology.
R. D. G. Hanlon.
Hydrobiologia, Vol 88, No 3, p 281-288, May, 1982. 3 Fig, 2 Tab, 28 Ref.

Descriptors: *Litter, *Decomposition, *Energy conversion, Invertebrates, Oligotrophic lakes, Lakes, Llyn Frongoch, *Wales, Leaves, Aquatic plants, Macrophytes, Nutrients, Organic matter.

The breakdown and decomposition of leaf litter from two deciduous trees and from two species of aquatic macrophytes were investigated in an oligotrophic lake, Llyn Frongoch, Wales. During the one year's submergence in the lake, starting in November, the litter in coarse mesh bags decomposed more rapidly than litter in fine mesh bags. This was probably a result, not of invertebrate feeding, but of loss of leaf fragments through the coarse mesh. The fastest decaying litter was Isoetes lacustris L., followed by the other aquatic macrophyte, Potamogeton perfoliatus L., and the two deciduous leaf litters, Salix veminalis L. (common osier) and Fagus sylvatica L. (beech). Litter degenerated rapidly for the first month or two of leaching, then more slowly as a result of low temperature and low nutrient concentrations in the lake water. Only Isoetes in coarse bags degenerated totally before the beginning of the next year's leaf deposition, suggesting that this lake is accumulating organic matter. (Cassar-FRC)
W82-06895

COMMUNITY PHOTOSYNTHESIS AND RESPIRATION IN EXPERIMENTAL STREAMS,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
S. P. Sheldon, and M. K. Taylor.
Hydrobiologia, Vol 87, No 1, p 3-10, February, 1982. 4 Tab, 38 Ref.

Descriptors: *Photosynthesis, *Respiration, *Aquatic plants, Streams, Oxygen, Benthos, Macrophytes, Phytoplankton, Algae, Productivity, Open channels, Riffles, Epiphytes, Lotic environment.

Monticello experimental riffle-pool, open canopy, constant-flow channels were used to estimate changes in relative contributions to total stream photosynthetic and respiratory rates by various components of a stream community (plankton, benthos, macrophytes, and epiphytes). Macrophytes quickly became established in the pools during early spring. This produced self-shading, little growth during summer, and a die-back to the rhizomes in the fall. In the macrophyte-epiphyte

community (pool) photosynthesis rates (g oxygen per sq m per day) were 29.26 on June 13, 4.12-7.67 during the summer, and 0.14 on October 6; respiration rates (g oxygen per sq m per day) were 13.11 on June 13, 9-11 during the summer, and 0.77 on October 6. Riffles were colonized by benthic algal mats, established early in the spring. Photosynthesis rates (g oxygen per sq m per day) in the riffle benthos were 3.32 on June 13 and 8-11 during the summer, declining to 0.80 by October 6; respiration rates (g oxygen per sq m per day) were 11.87 on June 13, 8-11 during the summer and 1.57 on October 6. Planktonic photosynthesis and respiration were very low (maximum 1.5 g oxygen per sq m per day) in both pools and riffles. The pools were autotropic in spring, changing to heterotrophic by fall; the benthos, initially heterotrophic, became autotrophic after algal mat establishment and remained so until the fall. (Cassar-FRC)
W82-06896

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,
Alberta Univ., Edmonton. Dept. of Botany.
M. Hickman.
Hydrobiologia, Vol 87, No 1, p 21-32, February, 1982. 6 Fig, 5 Tab, 35 Ref.

Descriptors: *Thermal pollution, *Algae, *Lakes, Water pollution effects, Heated water, Power plants, Ephiphytes, Lake Wabamun, *Alberta, Standing crops, Species composition.

The effects of eliminating a powerplant heated water discharge on epiphytic algae in Lake Wabamun, Alberta, were documented from 1975 to 1978. Average surface water temperatures during the time of thermal pollution were 14-19 C warmer than ambient lake temperatures in winter and 8-9 C warmer in summer in the eastern part of the lake. Flow stopped on December 13, 1975. Peak seasonal standing crops were 209.6 mg per sq m chlorophyll a in 1971-72, 1491.7 mg per sq m in 1976, 469.0 mg per sq m in 1977, and 974.9 mg per sq m in 1978. Cocconeis placentula and Cladophora glomerata, dominant during the period of heated discharge, continued their dominance after 1975, but with greatly reduced population sizes. Oedogonium sp., Spirogyra sp., Stigeoclonium tenue, and Achnanthes minutissima decreased in sumbers. After 1975 the following species increased in importance: Epithema turgida, Rivularia haematities, Scytonema alatum, Mougeotia sp., Amphipleura pellucida, Nitzschia fonticola, Rhopalodia gibba, and Phormidium sp. (Cassar-FRC)
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,
Savannah River Ecology Lab., Aiken, SC.
J. H. Thorp, and M. R. Diggins.
Hydrobiologia, Vol 87, No 1, p 33-34, February, 1982. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Thermal pollution, *Cooling ponds, *Benthic fauna, Water pollution effects, Savannah River, *South Carolina, Nuclear powerplants, Insects, Aquatic insects, Midges, Dragonflies, Damselflies, Caddishflies, Mayflies, Invertebrates, Macroinvertebrates, Reservoirs, Species composition, Water depth.

The distribution and abundance of benthic macroinvertebrates were studies in Par Pond, a 11 ha cooling reservoir located at the Savannah River nuclear plant, South Carolina. Sediment samples were taken at 10 water depths from 0.16 to 5 m during January-April 1978 at two sites: (A) intermittently heated by thermal discharges and (B) at ambient temperatures. The relationship between abundance of organisms and water depth was more complex than the inverse relationship generally reported in the literature. Generally, odonates occurred at depths < 1 m and were more abundant at Site B. Of the dipterans, Ceratopogonidae (biting midges) had the most even distribution with depth, Chironomids (true midges) were found mostly at 1-3 m depths, and chaoborus (phantom midges) were usually in deeper water. Diptera abundances were similar at both stations, but earlier hatching occurred at Station A. The abundance of Caenis (a mayfly) and Trichoptera did not vary significantly with depth. Caenis was far more abundant at Station A, and Trichoptera was more abundant at Station B. Size was not a significant function of depth or sampling location for most genera of Odonata and Trichoptera. (Cassar-FRC)
W82-06899

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,
Tokyo Metropolitan Univ., (Japan). Dept. of Biology
H. Kunii, and K. Maeda.
Hydrobiologia, Vol 87, No 45-55, February, 1982. 5 Fig, 3 Tab, 33 Ref.

Descriptors: *Seasonal variation, Water quality, *Aquatic plants, Ponds, Lakes, Eutrophic lakes, Ojaga-ike, *Japan, Dissolved oxygen, Plant populations, Population dynamics, Macrophytes.

Seasonal and long-term changes in aquatic plants were studied in Ojaga-ike, a shallow eutrophic pond near Tokyo, Japan. Part of a continuing study started in 1971, this paper reports results of 1978 observations. Five species of the 10 floating-leaved and submerged plants in the pond showed changes in surface cover during the year. Potamogeton crispus and Elodea nuttallii occupied 53-5% of the total pond surface in May; Trapa natans and Nelumbo nucifera, 79.1% in July; N. nucifera and Hydrilla verticillata, 62.0% in September; and N. nucifera, 41.2% in November. The plant population and water quality were strongly related during the summer. The aquatic plants produced high dissolved oxygen concentrations in the surface water, while decomposition of plant materials caused oxygen depletion near the bottom. This condition caused an unfavorable encironment for some plants, including Charophyceae. Long-term changes were observed since 1971. Nymphyoides, Myriophyllum, and Hydrilla have been decreasing in number and range, whereas two newly established plants, Nelumbo and Elodea, have become dominant. These changes were probably a result of light completion and drying of exposed tubers during water level lowering in winter. The present order of plant dominance is Nelumbo > Trapa > Elodea = Myriophyllum > Vallisneria > Najas. It is expected that the pond will become monotypic, with Nelumbo being the main species. (Cassar-FRC)
W82-06900

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,
Florida University, Gainesville School of Forest Resources and Conservation.
D. E. Canfield, J. R. Jones, and R. W. Bachmann.
OWRT A-063-IA, Hydrobiologia, Vol 87, No 1, p 65-76, February, 1982. 2 Fig, 8 Tab, 44 Ref.

Descriptors: *Phosphorus removal, *Eutrophic lakes, *Sedimentation rates, Fate of pollutants, *Iowa, *Lake sediments, Trophic level, Seasonal variation, Chemistry of precipitation.

Mean phosphorus sedimentation rates, as determined by sediment traps, were 13.3 to 218 mg per sq m per day in four natural and four artificial Iowa lakes. Although P sedimentation rates for the natural lakes as a group were not significantly different from rates for artificial lakes, there were significant differences in P sedimentation rates for individual lakes, at different locations within a lake, at different depths within a location, and during different seasons. However, P sedimentation rates were strongly correlated with inorganic sediment concentrations and inorgaic matter sedimentation rates. The trophic status of the lakes as measured by chlorophyll a concentrations was also a function of P sedimentation rate. For example, a lake with mean P sedimentation rate of 13.3 mg per sq m per day had a chlorophyll a concentration rate of 4.0 mg per cu m; a lake with a 218.1 mg per sq m per day P sedimentation rate had a chlorophyll a concentration of 81.0 mg per cu m. Sedimentation traps did not measure net sedimentation rates, and should not be used unless resuspension and resedimentation of bottom sediments are minimal. (Cassar-FRC)
W82-06901

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,
Michigan University, Ann Arbor. Great Lakes Research Division.
For primary bibliographic entry see Field 5A.
W82-06902

MODIFICATION OF BENTHIC INSECT COMMUNITIES IN POLLUTED STREAMS: COMBINED EFFECTS OF SEDIMENTATION AND NUTRIENT ENRICHMENT,
Wake Forest University, Winston-Salem, North Carolina, Department of Biology.
A. D. Lemly.
Hydrobiologia, Vol 87, No 3, p 229-245, March, 1982. 7 Fig, 10 Tab, 59 Ref.

Descriptors: *Benthic fauna, *Silting, *Nutrients, Water pollution effects, Aquatic habitats, Habitats, Awuatic insects, Insects, Acidic water, Species diversity, Turbidity, Suspended solids, Plecoptera, Diptera, Synergistic effects, Sedimentation, Nitrates, Phosphates, Bacteria, Sphaerotilus natans, Biomass, Streams, Cullowhee Creek, *North Carolina, Caddisflies, Filamentous bacteria.

Water quality, substrate composition, and benthic insect populations were monitored in three zones of Cullowhee Creek, located in the Applachian mountains of North Carolina, over an 8-month period. Zone 1 had no sediment or nutrient enrichment; Zone 2, sediment only; Zone 3, sediment and nutrient enrichment with low levels of livestock pasture runoff. Water in the two zones receiving sediment had high turbidities, suspended solids, and bed load; minimum dissolved oxygen levels of 7.6 mg per liter; and pH, 6.6; the maximum substrate temperature was 19 C in August. Water in Zone 3, receiving livestock runoff, had higher nutrient levels, 0.076-0.140 mg per liter phosphate and 0.93-1.41 mg per liter nitrate. The species richness, diversity, and total biomass of filter feeding Trichoptera and Diptera, predaceous Plecoptera, and certain Ephemeroptera were significantly reduced in sediment-polluted zones. The primary factors affecting the filter feeders were filling of interstitial spaces in the substrate and deposition of sediment on insect body surfaces and respiratory structures. The nutrients promoted growth of the filamentous bacteria, Sphaerotilus natans, on the insects and on the surfaces of stones. This growth, combined with the fine sediments, contributed to the smothering effect. The accumulation of sediment and S. natans in gill structures was shown in several photographs. The acid sensitive species, Plecoptera and Ephemeroptera, were also affected by the depressed pH at the substrate in streams with already acid waters. Synergism of sediment and nutrient-promoted bacterial growth eliminated a significantly greater number of taxa than one pollutant alone. (Cassar-FRC)
W82-06903

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS).
Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.

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For primary bibliographic entry see Field 5B.
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,
Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
For primary bibliographic entry see Field 5B.
W82-06905

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,
Maryland Univ., College Park. Dept. of Zoology.
G. A. Wyngaard, J. L. Elmore, and B. C. Cowell.
Hydrobiologia, Vol 89, No 1, p 39-48, April, 1982. 4 Fig, 35 Ref.

Descriptors: *Seasonal variation, *Population dynamics, Zooplankton, *Copepods, *Mesocyclops edax, Chlorophyll a, Eutrophic lakes, Lakes, Subtropic zone, Lake Thonotosassa, *Florida, Growth rates.

The zooplankton community of eutrophic Lake Thonotosassa, Florida, (345 ha, 2.5 km long, 1.5 km wide, mean depth 3.5 m) was studied from July 1976 to June 1977. The numerically dominant crustacean, Mesocyclops edax, had a stationary age distribution from July to March. The per capita growth rate was near zero through most of the year, showing an equilibrium between birth and death rates. In spring and summer death rates were higher, a result of predation by Diaptomus dorsalis, rotifers, and fish. In contrast to M. edax, other plankton (rotifers, D. dorsalis), chlorophyll a, and temperature showed marked seasonal variations. Zooplankton species composition was low and cladocerans were scarce compared with temperate lakes. (Cassar-FRC)
W82-06906

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, J. B. W. Wanders, and J. R. Moed.
Hydrobiologia, Vol 88, No 3, p 233-244, May, 1982. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Chelation, *Bioassay, Phosphorus, Nitrogen, Silicon, Copper, Algae, Growth rates, Heavy metals, Metals, Humic acids, Fulvic acids, Oscillatoria, Iron, Tjeukemeer, *The Netherlands, Toxicity, Water pollution effects.

The multiple addition bioassay technique, using phytoplankton populations present in the test water, was applied to water from eutrophic Lake Tjeukemeer, the Netherlands. This shallow water body, used for water level regulation, has transparent, chloride-rich water in summer and brown, nutrient-rich humic water in winter. Nitrogen, not phosphorus, was the principal factor limiting algal growth during May-November, 1979, a period in which Oscillatoria agardhii was dominant. On some sampling dates P was the second most important limiting nutrient. Omitting chelated Fe (Fe-ethylenediamine tetraacetic acid) from the algal cultures was growth limiting during periods of low dissolved Fe concentrations in the water. However, omitting inorganic Fe increased growth. The presence of the chelating agent may have affected growth by detoxifying toxic metals. Omitting the trace elements B, Co, Cu, Mn, Mo, and Zn during the summer and fall season also promoted algal growth. Although the natural Cu levels in the water were not determined, it is suspected that these have reached toxic levels in Tjeukemeer. The results of this study suggest that trace metals inhibit growth when the lake contains humus-poor water with low metal binding capacity. (Cassar-FRC)
W82-06907

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,
Hong Kong Univ., Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-06908

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,
Freshwater Fisheries Lab.
R. Harriman, and B. R. S. Morrison.
Hydrobiologia, Vol 88, No 3, p 251-263, May, 1982. 4 Fig, 6 Tab, 54 Ref.

Descriptors: *Forest watersheds, *Acid rain, *Streams, Watersheds, Salmon, Trout, Fish, Mayflies, Invertebrates, Acid streams, Acidic soils, *Scotland, Water pollution effects, Spruce trees, Trees, Fish eggs, Air pollution, Water quality.

Precipitation, water, invertebrates, and fish were studied in 12 streams flowing through forested and non-forested catchments west of Aberfoyle, Scotland. Bedrock in this region is predominantly quartzite, schists, and slates with little buffering capacity. Precipitation has an annual mean pH of 4.2-4.5. The most common tree species is Sitka spruce (Picea sitchensis Carriere). Forest streams were more acid than adjacent moorland streams (mature forest, 4.16-4.75; young forest, 4.83-5.25; and moorland, 4.90-5.80). Concentrations of aluminum were also higher in old forested streams (100-350 micrograms per liter) than in young forest and moorland streams ((< 100 micrograms per liter). Manganese concentrations were 90 micrograms per liter in forest streams and 30 micrograms per liter in non-forested streams. Among the mature forest streams only one had brown trout (Salmo trutta L.); all non-forested streams had trout. Planted salmon eggs (Salmo salar L.) died within a few weeks in forested streams but survived in non-forested streams. The only mayfly nymph found in acid streams during summer was Siphlonurus lacustris Eaton. In winter samples mayfly nymphs, Heptagenia lateralis Curtis, were found in one forest stream, but several species were present in non-forested streams. Data suggest that spruce forests collect acid pollutants and denude the soil of neutralizing elements, producing higher acidity in streams draining forested catchments. (Cassar-FRC)
W82-06909

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,
Maine Cooperative Fishery Research Unit, Orono.
J. R. Moring.
Hydrobiologia, Vol 88, No 3, p 295-298, May, 1982. 1 Fig, 30 Ref.

Descriptors: *Permeability, *Streambeds, *Logging, Gravel, Fish eggs, Clear-Cutting, Forest watersheds, Water pollution effects, *Oregon, Sediment, Hatching, Salmon, Trout, Tributary streams.

Three second-order tributary streams of the Alsea River, Oregon, were studied from 1962 to 1973 to determine the effects of logging on stream gravel permeability. Needle Branch drainage basin was 82% clear-cut, Deer Creek was 25% clear-cut with 30 m wide uncut buffer strips along the stream banks, and Flynn Creek, the control, was uncut. Road construction was completed in 1965, and logging was finished by 1967. The average gravel permeabilities decreased significantly in the clear-cut basin, from about 4900 cm per hour prelogging to 1100 cm per hour the first year after logging, increasing to 2400 cm per hour for the next 6 years. In the control and partially cut basins gravel permeabilities were not significantly different throughout the study. Monitoring gravel permeability may be more useful than determination of sediment fines in assessing the suitability of gravel conditions for salmonid eggs and alevins. (Cassar-FRC)
W82-06910

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,
Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
A. D. Lemly, and J. F. Dimmick.
Hydrobiologia, Vol 88, No 3, p 299-307, May, 1982. 3 Fig, 2 Tab, 53 Ref.

Descriptors: *Species composition, *Zooplankton, *Littoral zone, Population dynamics, Lakes, *North Carolina, Eutrophic lakes, Oligotrophic lakes Predation, Invertebrates, Seasonal variation, Cladocera, Copepods, Rotifers, Ostracoda, Cyclops.

Species composition and seasonal dynamics of zooplankton in the littoral zone of three North Carolina lakes were studied from October 1978 to September 1979. Belews Lake was considered oligotrophic; Salem Lake and Lake 150, eutrophic. A total of 32 species were found in the three lakes. Although the oligotrophic lake had as many species as the eutrophic lakes, many were rotifers, not truly littoral species, Belews Lake had 7 species of Cladocera vs. 11 in the eutrophic lakes. The eutrophic lakes had considerably more aquatic macrophytes in the littoral zone than the oligotrophic lake, providing a habitat able to support a greater number of zooplankton species. The littoral fauna, represented by certain taxa of Cladocera and Copepoda, had seasonal dynamics different from those of the limnetic fauna (Rotifera and Ostracoda), possibly as a result of predator pressure. There were no predators among the true littoral fauna, which were represented by Alona, Chydorus, Pleuroxus, Sida, Simocephalus, and Eucyclops. These genera showed very similar seasonal dynamics even in widely separated geographical regions, indicating that the population fluctuations were not dependent on climatic or chemical variables. Intrazooplankton predation by the limnetic species, mainly Cyclops bicuspidatus, appeared to be the major factor influencing the seasonal dynamics of the true littoral species. (Cassar-FRC)
W82-06911

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,
Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
For primary bibliographic entry see Field 5G.
W82-06912

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBE-ASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).
Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
A. Kohler.
Helgolander Meeresuntersuchungen, Vol 34, No 3, p 263-285, 1981. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Estuaries, *Fish, *Oxygen depletion, *Nuclear powerplants, Fishkill, Bioindicators, *Elbe river, *West Germany, Flounders, Eel, Smelt, Fish migration, Spawning, Entrainment, Water temperature, Water pollution, Cooling water, Industrial water, Seasonal variation, Rivers, Water pollution effects.

Continuous sampling of 22 species of fish (focusing on Platichthys flesus L., Osmerus eperlanus L., and Anguilla anguilla L.) was performed during 1978 at the intake of the cooling system of the nuclear power plant at Brunsbuttel in the Elbe estuary (West Germany). The goal of the study was to assess the influence of the abiotic factors water temperature, inflow from the upper Elbe and oxygen content of the river on the natural fluctuations of the fish community at various seasons and to investigate doubts about the efficacy of the fish-repelling device ('fish scarecrow') at the plant. It was found that seasonal changes in water temperature determined spawning times and migration.

The fish drawn into the cooling system formed a representative picture of the ichthyofauna of the estuary. The fish-repelling device was ineffective; it was estimated that when the cooling system was working at its full capacity of 130,000 cu m/hour at least 190,000 kg of fish and shrimp were drawn in and killed. Although the heavy pollution of the lower Elbe did not appear to affect water temperature, the oxygen content was largely dependent on the inflow of fresh water from the upper Elbe. The smelt spawning period was at least 44 days long, compared with 26.8 days at the end of the 1950s, and the fish only migrated upstream to the spawning areas at times of high freshwater inflow. A two-week period of severe oxygen depletion (5.19-6.2.1978) resulted in the largest fishkill in 30 years. This affected certain age groups of smelt and eel, while most flounder were able to migrate. A failure of the industrial filter plants at Brunsbuttel may have caused the oxygen depletion. (Gish-FRC)
W82-06913

SUBSTRATE-ASSOCIATED MICROFAUNA,
Environmental Protection Agency Region VI, Dallas, TX.
G. A. Burton, Jr., and J. M. Lazorchak.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 922-931, June, 1982. 88 Ref.

Descriptors: *Literature reviews, *Microenvironment, *Reviews, Benthic fauna, Aquatic animals, Benthos, Fauna, Benthic environment, Indicators, Bacteria, Heavy metals, Agricultureal chemicals, Pesticides, Water pollution effects, Microbiological studies, Water quality, Toxicity.

Current research in the area of substrate-associated microfauna is cited in this literature review. Methodology papers included discussions of sampling techniques, sampling devices, methods for studying benthic communities, and methods for investigating wastewater plant organisms. Ecology studies included the investigation of fouling communities and colonization of substrates, the distribution of substrate-associated microfauna, a one year study of water quality in Big Thicket National Preserve, factors affecting the distribution of littoral invertebrates, the distribution of micro-, meio-, and macrofauna biomass (suggesting nutrient inputs from intrusions of deep Gulf Stream waters) at the self break on the Georgia Bight, macro- and meiobenthos of Lake Michigan, benthic distribution studies in Antarctica, planktonic and benthic meiofaunal studies in saline lakes of Antarctica, the energetics of sandy beaches along South Africa, ciliates typical of waste treatment systems, effects of resource variation on the ciliate Tokophrya lemnarium, spatial distributions and interactions of Paramecium aurelia complex in littoral zones, protozoa and vascular vegetation in various wetlands, morphometric variability of the tardigrade Isohypsibius saltursus and several studies on the relationship between invertebrates and food uptake. Toxicity studies were made concerning thermal tolerances, chronic chlorination, petroleum responses, chlordane, endosulfan, methyl mercuric chloride, heavy metals, and wastewater pollution. Technical advances have been made in pollution studies. (Baker-FRC)
W82-06925

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 980-983, June, 1982. 24 Ref.

Descriptors: *Literature reviews, *Public health, *Reviews, *Drinking water, *Water pollution effects, *Human diseases, Salmonella, Legiionella pneumophila, Campylobacter jejuni, Pulmonary disease, Giardiasis, Gastroenteritis, Viruses, Cholera, Sparganosis, Epidemiology.

Current research into disease outbreaks cause by drinking water contaminants is cited in this literature review. During 1979 41 waterborne disease outbreaks were reported to the Centers for Disease Control and the US EPA. In epidemiological studies the incidence of amoebic and bacillary dysentery, infectious hepatitis, enterobiasis, and giardiasis before the afte construction of water tower reservoirs and automatic chlorination plants was considered in the Wadi Shati area in Libya. During 1981 only one waterborne clolera outbreak occurred in the US and was investigated. The incidence of cholera in a randomly selected sample of families in rural Bangladesh was followed over a 10 year period. Giardiasis was studied after a community wide outbreak of gastrointestinal illness occurred in Berlin, New Hampshire. Outbreaks of giardiasis were also studied in a small northwestern Pennsylvania town and in Arizona. Viral gastroenteritis was studied in cases caused by a virus serologically related to Norwalk virus near Tacoma, Washington in May of 1978. An outbreak of acute gastrointestinal illness at a camp in North Carolina was linked to a Norwalk type virus. A commonsurce waterborne epidemic of viral hepatitis was diagnosed in Kashmir, India. Campylobacter enteritis was studied after its occurrence in central Sweden, having been spread through infected water mains. Sparganosis was noted in persons haveing drunk water not from the local public water supply. Pulmonary disease was linked with shower fixtures from which Legionella pneumophila was isolated. Studies were also made of Mycobacterium xenopi as another pulmonary pathogen frequently isolated from tap water. (Baker-FRC)
W82-06928

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,
Oklahoma State Univ., Stillwater, Dept. of Botany.
D. A. Francko, and R. T. Heath.
Limnology and Oceanography, Vol 27, No 3, p 564-569, May, 1982. 4 Fig, 27 Ref.

Descriptors: *Bogs, *Chemical reactions, *Phosphorus, *Iron, *Humic acids, Ultraviolet radiation, Radiation, Light intensity, Lakes, *Bog lakes, *Ohio, Crazy Eddie Bog.

The release of orthophosphate from UV-sensitive complex P compounds was studied as a potentially ecologically important photodependent process involving the photoredution of iron. Lake water samples were collected from Crazy Eddie Bog, a shallow humic bog lake in northeastern Ohio. The lake is in a small old-field watershed surrounded by a marsh community dominated by Sphagnum. The concentration of dissolved humic substances in the water substances varied seasonally, being lowest in early spring, increasing in June, and reaching the highest concentration in late summer and early autumn. Throughout the season daytime concentrations of UV-sensitive complex P were linearly related to cochromatographic dissolved high molecular weight humic matter (DHM) adsorbance eluted in each chromatographed sample. The relationship was consistent in both relatively unstained and highly stained water samples. This fits in with the view that DHM had formed a complex with phosphate and that this complex can be broken by low doses of UV light. The UV in sunlight may have altered the DHM/phosphorus compounds, resulting in the release of phosphate. A diurnal fluctuation was noted both in the concentration of DHM and in the amount of UV-sensitive complex P. The amounts of DHM and UV-sensitive complex P were also linearly related. The rate of photoreduction of DHM/iron was the same as the rate of photoreduction of ferric citrate under similar conditions. Reduced DHM/iron was auto-oxidizable; ferrous citrate was not. These data support the view that orthophosphate sorbed to ferric iron/DHM complexes may be released by a mechanism involving UV-induced photoreduction of ferric iron to the ferrous state. (Baker-FRC)
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,
Water Research Lab., Columbus, OH., Div. of Water.
R. C. Lorenz, and C. E. Herdendorf.
Journal of Great Lakes Research, Vol 8, No 1, p 42-53, 1982. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Lakes, *Algal growth, *Lake Erie, Great Lakes, *Eutrophication, Phosphorus, Nitrogen, Nutrients, Seasonal variations.

In situ growth rates, densities and distribution of Cladophora were examined in the western basin of Lake Erie, and possible relationships between environmental conditions and Cladophora growth were examined. The findings showed that Cladophora colonized the littoral zone throughout western Lake Erie wherever suitable substrate was available. Within this littoral zone two distinctive growth patterns, representative of two different environments, are exhibited. The eulittoral zone supports growth from May to December, in contrast to the bimodal growth pattern of the infralittoral zone, which lacks growth in the late summer, August and September. Light and substrate availability limit the extent of Cladophora growth in western Lake Erie. Field observations indicated that light levels of about 50 microE/square meter-second or less are limiting. In the island region an extensive infralittoral zone composed of bedrock shorelines and reefs provides an excellent substrate for the alga to colonize. Much of the remaining Ohio and Michigan shorelines consists of low lying marshes and unconsolidated sediment, unsuitable for colonization. Available forms of phosphorus and nitrogen are abundant and do not become limiting, as evidenced by tissue nutrient analysis. The absence of the alga in the infralittoral zone during the late summer months of July and August is the result of a negaive energy balance. Respiration surpasses productivity as temperatures rise in the summer. The decreasing biomass of the infralittoral zone in the summer is accompanied by increasing epiphyte colonization and declining, but not limiting, tissue phosphorus and nitrogen levels. (Baker-FRC)
W82-06932

SECONDARY BENTHIC PRODUCTION IN A TROPICAL ISLAND STREAM,
Indiana State Board of Health, Indianapolis.
G. R. Bright.
Limnology and Oceanography, Vol 27, No 3, p 472-480, May, 1982. 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Tropical regions, *Benthos, Aquatic life, Climatic zones, Seasonal variations, Caroline Islands, Rainfall, Streams, Temperature effects, *Palan Islands, Ngerekiil River.

Benthic production was measured in a tropical stream on an oceanic island, the largest of the Palau group. The Palau Islands lie in the equaorial Pacific, 90 km east of the Philippines and an equal distance north of New Guinea. The climate is tropical and wet, with temperatures never deviating more than 6 degrees from a mean of 27 degrees C and rainfall averages of about 375 cm per year. The driest months are February through April. The study stream flows from its source about 150 meters above sea level for a 5 km distance and joins the larger Ngerekiil River near its estuary. The area of the watershed is 3.5 square km. Both the stream and the watershed are nearly pristine. There was no general pattern of synchronized life cycles tuned to seasonal changes as is typical in benthos of temperate streams. However, at least two important benthic species underwent population cycles possible related to seasonal precipitation changes. The shrimp A. pilipes had a peak population and standing crop in February, while the largest number of mature individuals was found in October. Larvae of the blackfly Simulium palauensis had a peak density and peak standing crop biomass in November, with the highest percentage of last instars in April. The outcrop and riffle communities in the stream were composed mainly of rheophilic species, but the community structures, mean densities, mean standing crops, and productions differed considerably. (Baker-FRC)
W82-06933

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MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,
University of Southern California, Los Angeles, Dept. of Geological Sciences.
R. H. Osborne, G. R. Licari, and M. H. Link.
Sedimentary Geology, Vol 32, No 1/2, p 39-61, 1982. 8 Fig, 1 Tab, 38 Ref.

Descriptors: *Carbonates, *Algae, *Chemical precipitation, *Stromatolites, Walker Lake, *Nevada, Lakes, Shores, Cladophora, Ulothrix, Photosynthesis, Siliciclastic lakes, Chlorophyta, Cyanophyta, Carbon dioxide, Bicarbonates, Calcite, Benthic flora, Epilithic algae.

The occurrences of generalized and columnar stromatolites in a modern, closed siliciclastic lacustrine basin, Walker Lake, Nevada, and their formation by benthic and epilithic algal communities are documented. The two most abundant algae in the stromatolite community are Cladophora glomerata and a Ulothrix species. These are able to remove carbon dioxide from bicarbonate during photosynthesis, resulting in the precipitation of calcium carbonate, which is trapped and bound by an understory of green and blue-green algae. In the siliciclastic lakes stromatolite development seems to be restricted to shoreline and near shore environments. This characteristic can be useful in locating ancient lake shores. The biological and physical factors most important in the formation of stromatolites in this lake are summarized. Bedrock and stable pebble- to boulder- size clasts are suitable substrates for the benthic and epilithic algae. The best algal growth occurs in shallow, well-mixed, well-aerated, nonturbid water. Low Mg calcite precipitation, associated with the algal community, occurs in shoreline areas. Small generalized stromatolites form initially. These give rise to columnar forms. Periodic wave action erodes the stromatolites, providing a local source of carbonate sediments, usable for further stromatolite formation in an otherwise carbonate-poor lake. (Cassar-FRC)
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,
State Univ. of New York Coll. at Fredonia, Dept. of Biology.
K. E. Mantai, P. E. Garwood, and L. E. Peglowski.
Journal of Great Lakes Research, Vol 8, No 1, p 61-65, 1982. 2 Fig, 7 Ref.

Descriptors: *Algal growth, *Lakes, Nutrients, Phosphorus, Nitrogen, *Lake Erie, Great Lakes, Eutrophication, *Cladophora.

Biomass and several physiological and environmental parameters were measured dealing with Cladophora samples collected from two sites in eastern Lake Erie. Samples were collected from Point Gratiot and a Niagara Mohawk Paper Company breakwall. These sites are about 1 kilometer apart near the habor at Dunkirk, New York. Seasonal variation in standing crop was dramatic, with increases during early June, followed by a rather stable period culminating in a sharp decrease in Mid-July. The fluctuations in standing crop observed during June appeared to be caused by loss of algal material due to physical detachment of the filaments, followed by rapid regrowth. The data suggest that there is a maximum biomass level which, when attained, makes the cells more vulnerable to breakage. At the Niagara Mohawk Paper Company site the maximum biomass level was about 400 g dry wt/square meter. The mid-July drop in biomass represents the typical summer dieoff observed in many studies. A significant correlation was noted between biomass and chlorophyll content. Chlorophyll content tended to be high or increasing during periods of rapid growth, but was lower at times when biomass density decreased. Changes can occur rapidly in the time span of one day. Neither nitrogen nor phosphorus were limiting to the growth of Cladophora at the sites sampled. The mid-summer dieoff does not appear to be due to a simple nutrient deficiency. (Baker-FRC)
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,
Ontario Ministry of the Environment, Rexale, Limnology and Taxonomy Section.
M. B. Jackson, and Y. S. Hamdy.
Journal of Great Lakes Research, Vol 8, No 1, p 153-163, 1982. 7 Fig, 3 Tab, 35 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, *Cladophora, Georgian Bay.

The potential for Cladophora growth in the vicinity of a proposed municipal sewage treatment plant discharge to the Mary Ward Shoals area of southern Georgian Bay was investigated. A simple model is presented for predicting seasonal Cladophora production at three alternative discharge sites. Light, temperature, water movement and substrate characteristics of southern Georgian Bay provided favorable growth conditions for Cladophora. Growth appears limited by nutrient availability, as the alga grows only in association with local and well defined sources of nutrients such as harbor areas, municipal sewage treatment plant discharge locations, river and stream mouths, storm sewers, septic systems, and gull rookeries. Cladophora growth was severely phosphorus limited on the Mary Ward Shoals. Mean phosphorus concentrations on the Mary Ward Shoals at station SHB are above the suggested lower level for Cladophora growth. In spite of this, however, the alga is essentially absent from the shoal area. The reason is that average phosphorus concentrations in shallow nearshore areas do not necessarily reflect sustained or predominant external nutrient conditions. It was concluded that any proposed outfall should be long enough to ensure that the zone of impact does not encompass any water with depth shallower than 10 meters. Also, the sewage system should have a good outfall diffuser and the plant should be designed to produce an effluent quality of 500 micrograms phosphorus/liter or less. (Baker-FRC)
W82-06936

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,
Michigan University, Ann Arbor, Great Lakes Research Division.
R. J. Stevenson, and E. F. Stoermer.
Journal of Great Lakes Research, Vol 8, No 1, p 184-195, 1982. 9 Fig, 2 Tab, 20 Ref.

Descriptors: *Diatoms, *Lakes, *Lake Huron, Great Lakes, Algal growth, *Cladophora, Wastewater disposal, Nutrients, Wastewater pollution, Water pollution sources.

The population and taxocene patterns of diatoms on Cladophora in Lake Huron were investigated as a function of distance from a point source of municipal wastewater treatment plant effluent. The diatom proportion of the Cladophora-epiphyte assemblage biomass was also investigated. The study area was located near Harbor Beach, Michigan, on Lake Huron. Epiphytic diatoms were collected from July to September 1979 at various distances from a point source of municipal wastewater treatment plant effluent entering Lake Huron. Diatom accumulation rates were positively related to the distance from the point source. Despite higher nutrient concentrations nearest the point source, low accumulation rates of Cladophora epiphyte assemblage biomass and epiphytic diatoms indicated moderate growth inhibition by an undetermined factor. Evaluation of epiphytic diatom population abundance and ecology plus diatom taxocene species diversity supported the conclusions. A curvilinear relationship between diatom species diversity and impacts of growth inhibition is proposed. The diatom proportion of Cladophora epiphyte assemblage biomass was positively related to distance from the point source of sewage effluent. (Baker-FRC)
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,
Wisconsin University, Platteville.
M. L. Anderson, C. P. Rice, and C. C. Carl.
Journal of Great Lakes Research, Vol 8, No 1, p 196-200, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Lakes, *Lake Huron, Great Lakes, *Cladophora, Organic chemicals, Industrial wastes, Accumulation, Algae, Water pollution sources, Food chains.

The accumulation of polychlorinated biphenyls by Cladophora along the Lake Huron shoreline was investigated. Detectable quantities of PCB were found in all of the water samples that were collected. The chromatograms for the residues were composed of a mixture of Aroclors, with most of the peaks accounted for by standard mixtures of Aroclor 1242 and Aroclor 1254. The concentration of Aroclor 1242 in the water samples averaged 91 ng/liter, while Aroclor 1254 was 63 ng/liter. Total PCB concentration of 154 ng/liter included both dissolved (52%) and particulate (48%) phases. Two days pior to sample collection in the area a major storm eent passed through, causing a significant resuspension of the sediments in the zone. The Cladophora averaged 92 ng/g dry weight of total PCBs. About 58% of this total was in the Aroclor 1242 fraction. The PCB concentration of fish in the area ranged from 40 ng/g to 4,400 ng/g as wet weight of whole fish. The accumulation factors observed in the progression from Cladophora to net plankton to fish were 1:15:30. It was concluded that Cladophora may effectively moderate the passage of PCB through the nearshore food chain. The role of Cladophora as a source of PCBs seems more supportable than as a sink. (Baker-FRC)
W82-06938

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,
Michigan Technological Univ. Houghton, Dept. of Civil Engineering.
M. T. Auer, R. P. Canale, H. C. Grundler, and and Y. Matsuoka.
Journal of Great Lakes Research, Vol 8, No 1, p 73-83, 1982. 15 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Eutrophication, Great Lakes, *Monitoring, *Model studies, Mathematical models, *Cladophora, Nutrients, Phosphorus, Nitrogen.

The ecology of Cladophora glomerata in Lake Huron was examined in a three year study. A mathematical model was developed which would prove useful in evaluating various management strategies for the control of this algal growth. A municipal wastewater treatment plant discharge point at Harbor Beach, Michigan was linked with several nuisance occurrences of this alga in Lake Huron. An intensive field monitoring program was started to record weather conditions daily and levels of dissolved and stored phosphorus and standing crop of Cladophora. The distribution of Cladophora was essentially symmetrical about the nutrient source. Seasonal variation in biomass was noted following the pattern of early spring growth, stabilization and midsummer senescence. The high degree of spatial and temporal heterogeneity in the nearshore environment was clearly evident. Wind direction and velocity importantly affect dissolved phosphorus distribution. Internal phosphorus levels reflect long term trends in wind and current regimes. The growth of Cladophora is importantly influenced by internal phosphorus levels, while the loss of algal material through sloughing is closely correlated with wind-storm events. The observations of nearshore dynamics point to the need for high sampling frequency in such systems. (Baker-FRC)
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN

LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,
Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
M. T. Auer, and R. P. Canale.
Journal of Great Lakes Research, Vol 8, No 1, p 84-92, 1982. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Algal growth, *Lakes, Great Lakes, *Lake Huron, Eutrophication, *Model studies, Mathematical models, Kinetics, Phosphorus, *Cladophora.

The factors of dissolved phosphorus availability and internal phosphorus pool size were examined as they pertained to field populations of Cladophora glomerata in Lake Huron. Kinetic coefficients needed for modeling the uptake process are developed. The studies showed that Michaelis-Menten kinetics describe substrate/uptake interactions appropriately. Results from 35 experiments conducted over two field seasons emphasized that the phosphorus uptake rate increased as dissolved phosphorus availability increased. Negative feedback on uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate as internal pools approach saturation. The absolute maximum phosphorus uptake rate for Cladophora was 4.5 % P/day. Values for the half-saturation constant for uptake varied with internal phosphorus pool size and ranged between 30 and 250 microgams phosphorus/liter. The data were fit to published mathematical expressions which describe uptake as a function of internal and external phosphorus levels. The expressions may be used in mathematical models simulating the growth of Cladophora. (Baker-FRC)
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,
Ecology and Environment, Incorporated, Buffalo, New York.
G. C. Millner, R. A. Sweeney, and V. R. Frederick.
Journal of Great Lakes Research, Vol 8, No 1, p 35-41, 1982. 5 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Erie, Great Lakes, Eutrophication, Nutrients, Nitrogen, Phosphorus, Seasonal variations, Biomass, Ammonia, *Cladophora.

The biomass and distribution of Cladophora were monitored at Lake Erie, and an attempt was made to determine possible relationships between environmental conditions and Cladophora biomass. Cladophora biomass reached peak values in late June and early July at both the Hamburg and Walnut Creek collection sites. Maximum biomass at the Hamburg sites was generally found at the 3 meter depth. The depth at which maximum biomass occurred at Walnut Creek varied with the time of year. However, the greatest biomass density generally occurred at the 12 meter and 1 meter sampling depths. The occurrence of biomass maxima at the 3 meter depth at the Hamburg site is thought to be more directly a function of physical disturbance at the shallower depths than of the presence of optimal growth conditions in deeper waters. The depth distribution of Cladophora at the Hamburg site may have been more greatly influenced by wave activity and drifting sand than at the Walnut Creek site. Greater sand accretion by waves associated with increased fetch between Hamburg and Walnut Creek and the prevailing southwest winds may be responsible for differences in Cladophora abundance with depth between the Hamburg and Walnut Creek sites. Reductions in Cladophora internal nutrient levels corresponded to decreased nutrients in the water. Internal total phosphorus levels showed a significant positive correlation with Cladophora biomass. Cladophora was nitrogen-limited at the Walnut Creek site during part of the study period. Nitrate + nitrite nitrogen showed a significant positive correlation with Cladophora biomass at that site. (Baker-FRC)
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,
Limnos Limited, Toronto, Ontario.
J. H. Neil, and M. B. Jackson.
Journal of Great Lakes Research, Vol 8, No 1, p 30-34, 1982. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Lakes, *Algal growth, *Phosphorus, *Lake Erie, Great Lakes, Seasonal variations, *Cladophora, Eutrophication, Nutrients.

Environmental conditions, Cladophora standing crop, and internal nutrient levels were determined in Lake Erie. The role of phosphorus in Cladophora growth was also investigated. The Rathfon Point study site was characterized by a series of shelving limesone points which annually support a heavy growth of Cladophora. The temperature at this spot reached 20 degrees C in late June and generally remained above this level until early September. Water clarity was variable, due principally to suspended materials associated with wind conditions. Phosphorus and nitrogen parameters which describe the nutrient environment showed some sample-to-sample variability but lacked any trend consistent with the observed changes in Cladophora standing crop. Nitrate-nitrogen levels showed a consistent reduction throughout the growing season, while soluble reactive phosphorus levels remained very low, approaching the limit of detection most of the time. The percent of coverage by Cladophora increased with increases in fertility, suggesting that growth within the physical limits established by the environment will vary directly with the availability of plant nutrients. Optimum growth occurred between temperatures of 10 and 20 degrees C. Data indicated that above 20 degrees C the plant becomes chlorotic, growth is limited and the biomass may be detached from the substrate. Phosphorus additions did not affect Cladophora growth until the fall, when water temperatures fell below 20 degrees C and vigorous growth was resumed in the vicinity of the experimental phosphorus discharge pipe. (Baker-FRC)
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,
Indiana Univ., Bloomington. Dept. of Biology.
D. H. Landers.
Limnology and Oceanography, Vol 27, No 3, p 428-439, May, 1982. 11 Fig, 5 Tab, 37 Ref. OWRT B-009-IND.

Descriptors: *Macrophytes, *Nutrients, Phosphorus, Nitrogen, Seasonal variation, Reservoirs, Lakes, Impoundments, Myriophyllum spicatum, Water analysis, *Chlorophyll, *Indiana, Decomposing organic matter, Phytoplankton, Biomass, Monroe Reservoir.

The effects of senescing stands of Myriophyllum spicatum on water chemistry and chlorophyll a were investigated in a large soft-water Indiana reservoir having an area of 16.8 square kilometers and a mean depth of 5.2 meters. A causeway divides the reservoir into two basins, and one narrow cut allows exchange between them. Annual and seasonal growing conditions for submerged aquatic plants in Monroe Reservoir can vary drastically. Most seasonal variation results from water level fluctuations far greater than in a natural lake of similar size. Differential temperature effects on decomposition were discounted as inconsequential. Replicate enclosures were used to isolate water columns over monospecific stands of M. spicatum until annual dieback began. Systems were sampled routinely for 119 days before, during and after fall dieback. Decomposing macrophytes supplied significant inputs of nitrogen and phosphorus to surrounding waters. Nitrogen inputs were sharply pulsed and never accounted for more than 2.2% of the annual allochthonous inputs. Phosphorus inputs from senescing plants equaled up to 18% of the annual total phosphorus loading for the reservoir. Annual dieback occurred in late summer and early autumn when conditions were suitable for phytoplankton response. Phytoplankton biomass showed significant increases in response to senescing macrophytes. (Baker-FRC)
W82-06943

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,
Lancaster University (United Kingdom), Department of Biological Sciences.
K. Jones.
Limnology and Oceanography, Vol 27, No 3, p 455-460, May, 1982. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Estuarine environment, *Nitrogen fixation, Estuaries, Environment, *England, Coastal waters, Sediments, River Lune estuary, Rivers, Temperature effects.

Acetylene reduction was studied in Morecambe Bay, which is comprised of large areas of tidal flats off the northwest coast of England. The sediments are soft enough to allow insertion of hollow cylinders without disturbing the particle distribution and moist enough to form gas-tight seals so that changes in the composition of gases in the cylinders can be monitored. Experiments were conducted in the Lune estuary near Lancaster. The results of in situ assays performed at monthly intervals indicate that nitrogen fixation occurs only from May through October and that the highest values coincided with the highest temperatures. Nitrogen fixing bacteria were most numerous in the surface layer, and only the Enterobacteriaceae and Desulfovibrio were abundant. The effects of temperature on acetylene reduction by cores were studied in the laboratory. Rates were maximal between 30 and 35 C and there was little activity below 10 C. Bacterial isolates tested for the effects of temperature on acetylene reduction showed a pattern similar to that found in the sediments. That is, they exhibited little activity at low temperatures and had optima at just above 30 degrees C. The dominating aquatic influence on the estuary was marine. Although the sediments contained low numbers of photosynthetic bacteria and cyanobacteria, some of those present are salinity tolerant and may contribute some fixed nitrogen to the sediments. It is unlikely that photosynthetic microorganisms play a significant part in sediment nitrogen fixation. Considerable increases in acetylene reduction were noted when cores were primed with carbon substrates. (Baker-FRC)
W82-06944

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. H. Everest, and W. R. Meehan.
In: Transactions of the 46th North American Wildlife and Natural Resources Conference, 1981, Wildlife Management Institute, Washington, D.C., p 521-530, 21 Ref.

Descriptors: *Forest management, *Range management, *Aquatic habitats, *Anadromous fish, *Logging, Erosion, Road construction, Grazing, Stream banks, Scour, Detritus, Organic matter, Dissolved oxygen, Water pollution sources, *Pacific Northwest U.S., Alaska.

The anadromous fishery resources of western North American are produced largely within forested watersheds. Forest and rangeland management activities that can influence the quality of anadromous fish habitat include timber harvest, road construction, and livestock grazing. Organic debris from forested watersheds of the Pacific Northwest and Alaska enters streams through direct litterfall, landslides, debris torrents, timber felling, and streambank erosion, plus blowdown of trees and branches. Large woody debris can create habitat for rearing salmonids, but may cause sedimentation in spawning areas. Large, naturally occurring debris can promote streambank stability and reduce streambed scour. Large accumulations of fine organic debris can adversely affect habitat by reducing dissolved oxygen and producing toxic leachates. Total removal of debris can result in a completely open channel, promoting streambed

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sour, steambank instability, and loss of fish habitat productivity. Debris torrents, a common mass erosion event in the Pacific Northwest, have a negative impact on habitat and production of anadromous salmonids in small streams immediately downstream from the torrent egress. Studies within a 1-mile reach of Knowles Creek, however, indicate that the total effect of debris torrents in that sediment-poor watershed tends to be positive. Preliminary results of a livestock grazing study do not show profound effects on fish populations among various grazing systems or between one to three years of season-long grazing and ungrazed controls. (Moore-SRC)
W82-06965

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,
Southeastern Forest Experiment Station, Asheville, NC.
T. J. Harshbarger, and P. E. Porter.
Forest Service Research Note SE-308, June, 1982. 10 p, 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Dam effects, *Environmental effects, *Wastewater pollution, *Fish populations, *Water pollution effects, Invertebrates, Nutrients, Oligotrophy, Fish migration, Fish food organisms, Biomass, Bacteria, Periphyton, Trout, *Appalachian region.

Bent Creek is a third-order stream which supports a put-and-take trout fishery in North Carolina. An undisturbed section of the stream, Station 1, was located 250 m above Lake Powhatan, a 1.6-ha recreational impoundment. Impacted sites were Station 2, 100 m below Powhatan Dam; Station 3, 3,300 m below Station 2 and immediately below the confluence of Wesley Branch; and Station 4, 300 m below Wesley Branch. Wesley Branch is a first-order stream which receives 380,000 l/d of secondary sewage from a treatment plant. Treated sewage added to Bent Creek increased bacterial production by 476%, periphyton production by 191%, and the number of benthic macroinvertebrates by 441% biomass of fish decreased 56%. At Station 4, fish biomass was significantly greater than it was at upstream unenriched sections. Over the 300-m reach of water below Wesley Branch, nutrients decreased dramatically. The dam influenced fish distribution and upstream migration. The dam did not appreciably affect the number of macroinvertebrate taxa, but it did increase the abundance of some, particularly filter-feeding caddisflies and midges. It did not greatly alter physiochemical characteristics of the stream during the period of study. Tentatively, results indicate that sewage will change the ecology of oligotrophic streams like Bent Creek, but if it does enhance the production of a desired species, it may not be considered harmful. (Moore-SRC)
W82-06966

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,
Ontario Ministry of the Environment, Rexdale.
B. D. LaZerte, and J. E. Szalados.
Linnology and Oceanography, Vol 27, No 3, p 413-418, May, 1982. 3 Fig, 1 Tab, 36 Ref.

Descriptors: *Macrophytes, *Natural waters, Plants, Carbon, Lakes, Dissolved inorganic carbon, Lake Memphremagog, Fluctuations, Radioactive tracers, Isotope studies, *Quebec, Path of pollutants.

The stable carbon isotope ratio of submerged freshwater macrophytes was examined and an initial estimate was offered as to whether the organic carbon in a submerged macrophyte bed is autochthonous or of terrestrial origin. Major terrestrial carbon sources were wood and deciduous leaf litter. The results indicated that all stable carbon isotope ratios of the submerged macrophytes were substantially higher than those of terrestial C3 leaf litter and higher than the organic carbon ratios of a few preliminary sediment samples from one macrophyte bed in Lake Memphremagog. Epilimnetic dissolved inorganic carbon (DIC) ranged from 0.08 to 0.95 mM and pH from 7.4 to 8.1 over the summer season and along the main axis of the lake. The carbon ratio of the DIC was lower than that of DIC in equilibrium with the atmosphere; however, actual values varied widely. Variation was greatest at the southern end of the lake, where the influence of the inflowing rivers was most pronounced. It was concluded that the organic carbon of submerged freshwater macrophytes has a stable carbon isotope ratio distinctly higher than that of terrestrial C3 plants. This difference is probably a result of differences in diffusion resistance to carbon dioxide rather than of carbon dioxide fixation pathways, but is also influenced by the stable carbon isotope ratio of the DIC in the water. As a result, the stable carbon isotope ratio of these submerged freshwater macrophytes can be used to distinguish between them and terrestrial C3 material as sources of carbon in littoral communities. (Baker-FRC)
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
For primary bibliographic entry see Field 5B.
W82-06973

CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),
Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5A.
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,
Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W82-06975

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,
Wisconsin Univ.-Milwaukee, Dept. of Botany.
J. L. Blum.
Journal of Great Lakes Research, Vol 8, No 1, p 10-15, 1982. 5 Fig, 5 Ref.

Descriptors: *Algae, *Lakes, *Lake Michigan, Great Lakes, *Algal growth, Eutrophication, *Lake shorelines.

The seasonal development and spatial variation in the major components of attached algal populations on breakwalls and at other harbor and offshore sites on the western Lake Michigan shoreline are described. The discussion is presented on a seasonal basis, with the development of each algal component described chronologically. Evidence indicates that temperature, insolation, nutrient levels, wave action, and water level are important environmental factors which determine this pattern . Specific factors which determine the relative abundance of species within the waterline algal community may only be defined through careful autecological analysis. Field observations indicate that light requirements, resistance to desiccation and ice scour, and reproductive strategies are highly important features of the algal population dynamics of the nearshore environment. Of the three major filamentous algal forms present in this habitat, Bangia appears as a permanent resident, while Ulothrix may be considered a seasonal and opportunistic plant, responding rapidly to changes in water level. Cladophora is a perennial, but plants above a depth of about 30 cm tend to grow as annuals due to conditions of ice scour. It is suggested that seasonal and spatial variation in the abundance of particular species is related to the physical growth requirements of the species. (Baker-FRC)
W82-06976

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,
McGill Univ., Montreal,(Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06977

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,
Utah State Univ., Logan. Dept. of Biology.
R. D. R. Parker, and D. B. Drown.
Journal of Great Lakes Research, Vol 8, No 1, p 16-26, 1982. 11 Fig, 1 Tab, 35 Ref.

Descriptors: *Lakes, *Algal growth, Eutrophication, *Phosphorus, Nutrients, *Ulothrix zonata, *Lake Superior, Great Lakes, Phosphates.

The impact of phosphorus enrichment was determined and wave action was simulated on new and previously established populations of Ulothrix zonata from the north shore of Lake Superior. Baseline information was provided on the composition and magnitude of the periphyton community of Lake Superior. Tanks received constant flow of lake water and were exposed to the same insolation and climatic conditions as the lake for a 10-week period during July, August, and September 1972. A rocking tank and a stationary tank were enriched to maintain an average concentration of 0.16 mg/liter of phosphate phosphorus. Two remaining tanks, receiving only lake water, served as controls. Each week, algal material was harvested from the tanks and analyzed for chlorophyll a, ash-free dry weight, and abundance of U. zonata and associated non-filamentous periphytic algae. Diatoms comprised, on the average, 95% of the total non-filamentous periphytic algae. The results demonstrated that phosphorus enrichment had marked effects on established populations of U. zonata in addition to favoring recolonization of U. zonata on bare rock substrates. Statistical analysis of the data revealed that phosphorus enrichment caused a significant increase in Ulothrix biomass and chlorophyll a in the enriched tanks. Wave simulation caused a significant reduction in total numbers of non-filamentous algae associated with Ulothrix in the rocking tanks. (Baker-FRC)
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,
All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
V. V. Sapozhnikov, G. G. Shinkar, and A. A. Georgiev.
Water Resources, Vol 8, No 4, p 443-448, July/August, 1981. 3 Fig, 7 Ref. Translated from Vodnye Resursy, No 4, p 161-167, July/August, 1981.

Descriptors: *Eutrophication, *Oxygen, *Algae, Photosynthesis, Biological oxygen demand, Primary productivity, Reservoirs, Organic matter, Mozhaisk Reservoir, Measuring instruments, Wave action, Producitivity, Diurnal distribution, Hydrogen ion concentration, *USSR.

Oxygen concentration, primary production, and destruction were continuously measured by a production meter in the waters of Mozhaisk Reservoir.Galvanic-type electrochemical sensors using Ag and Pb in a 3M KOH solution were used as electrodes for measuring oxygen concentration. The meter recorded temperature, underwater illumination, and oxygen concentration; pH was determined by a separate meter. Diurnal variations of oxygen concentration ranged from 8.3 mg per liter at midnight to 8.6 mg per liter at 1400-1500 hours. At 1430 hours there was a temporary decrease to 8.4 mg per liter. The pH followed the same pattern from an 8.6 minimum to 8.8 maximum, with a slight, temporary decrease at 1430 hours. Gross and net production were illustrated in graphs for August 16, 1978. Net production measured by the production meter was 7.85 mg oxygen per liter, 6

times more than measured by the bottle technique. Maximum destruction values were recorded in the morning and at 4-4:30 pm. The maximum BOD recorded by the production meter was 0.20 mg oxygen per 30 min, 9 times higher than that measured by the bottle techniue. During stormy weather, heavy cloud cover and wave action increased BOD markedly due to a reduction in photosynthesis, an increase in suspended matter, and the death of cells. (Cassar-FRC)
W82-06982

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,
Belorussian State Univ., Minok (USSR).
G. A. Inkina.
Water Resources, Vol 8, No 4, p 448-452, July/August, 1981. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 4, p 168-173, July/August, 1981.

Descriptors: *Bacteria, *Wastewater pollution, *Self-purification, Water pollution effects, Rivers, *USSR, Plankton, Growth rates, Respiration, Microbiological studies.

The total number of planktonic bacteria, generation time, respiration rate, and efficiency of food assimilation were reported for several USSR rivers with varying anthropogenic loads. Volumes of individual bacterial cells varied from 0.10 to 0.27 cu microns for cocci and 0.50-0.76 cu microns for bacilli. Average numbers of bacteria ranged from 2.6 million cells per ml in the Volga to 17.72 million cells per ml in the polluted Svislock's River. There were significant increases in bacteria, up to 6-fold, below most municipal wastewater outfalls. Generation times were 18-44 hours, least in the Volga and most in the Dnepr. Downstream from wastewater outfalls the rates of reproduction were generally depressed. Average reproduction rates in unpolluted and mildly polluted rivers were 0.13 + or - 0.02 times 10 to the minus 9th power at 20 C. Wastewater from certain large cities increased this rate up to 10 times. The efficiency of use of assimilated energy by bacteria for their growth was 3-67%, average 33%. Values for sites downstream of cities were up to 10-fold less than upstream values. (Cassar-FRC)
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).
A. I. Kovrizhnykh, and L. I. Glavish.
Water Resources, Vol 8, No 4, p 452-456, July/August, 1981. 1 Fig, 11 Ref. Translated from Vodnye Resursy, No 4, p 174-179, July/August, 1981.

Descriptors: *Phytoplankton, *Self-purification, *Eutrophication, Water pollution effects, Water quality, Northern Donets-Donbas Canal, Canals, Diatoms, Nutrients, Algae, Organic matter, Heterotrophic bacteria, Bacteria, Biological oxygen demand, Stephanodiscus hantzshii, Cyanophyta, *USSR.

The phytoplankton of the flatland, river-fed Northern Donets-Donbas Canal, USSR, was dominated by diatoms, particularly Stephanodiscus hantzshii Grun., in the winter-spring period. The maximum number of S. hantzshii was 19,400-108,000 cells per ml during 1969-78, except for 1976, when the number did not exceed 5900 cells per ml. In some years several species of blue-green algae entered the canal from the Krasnooskol'skoe Reservoir, the incoming water containing from 17,900 to 223,800 blue-green algal cells per ml. During the periods of bloom water quality improved due to uptake of biogenic elements by the algae. Levels of ammonium, nitrite, nitrate, silicon, Fe, and phosphate were less than levels in incoming water. However, the organic matter comprising the phytoplankton greatly increased the load on water treatment plants, to a total of 52.8 tons per day fresh weight on one occasion. Although BOD5 increased during algal blooms, the relationship was not directly proportional. Generally the BOD in water leaving the canal was 10-99% greater than that entering it; on extreme occasions 133% and 214% increases were observed. In the presence of negligible diatom populations there was a 19-24% decrease in organic matter in outflowing water compared with inflowing water. As the diatoms died and decomposed, heterotrophic bacteria increased in number to 35-194% greater than in incoming water. These values were up to 14 times higher on certain occasions. Blue-green algae affected water quality similarly, but to a lesser degree, because they exist in lesser numbers. (Cassar-FRC)
W82-06987

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and A. H. Woodcock.
Pacific Science, Vol 35, No 3, p 257-261, July, 1981. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Eutrophication, *Drought, *Water level fluctuations, *Phytoplankton, Lakes, Eutrophied lakes, Mountain lakes, Alpine regions, Perched groundwater, Groundwater movement, Chlorophyll a, Nutrients, Interstitial water, Volcanos, Lake Waiau, *Hawaii, Nitrogen, Algae, Water pollution effects.

A drought during 1976-78 caused hypereutrophication in Lake Waiau, Hawaii, a small perched alpine lake near the top of the dormant volcano, Mauna Kea. This lake is remote from human influence. The volume of the lake decreased from 11,600 cu m to 3,700 cu m from May 1977 to March 1978. The lake level dropped from the normal yearly low of 25-30 cm below the overflow level to 180 cm below overflow in 1978. August chlorophyll a concentrations were (in mg per cu m): 17 in 1977, 6800 in 1978, 413 in 1979, and 280 in 1980. The usual phytoplankton community of diatoms and chlorophytes was replaced by an almost complete monoculture of the chlorophyte Nannochloris bacillaris. Nutrients to support this bloom were supplied by inflow of nutrient-rich interstitial water, especially in the nearshore areas, as a result of a 20-70 cm hydrostatic head between the perched groundwater around the lake and the lake surface. Two years after the drought's end, chlorophyll a levels were still higher than predrought levels. (Cassar-FRC)
W82-06991

5D. Waste Treatment Processes

A NOTE ON THE EFFECT OF CHLORINATION OF SEWAGE EFFLUENTS ON FAECAL COLIFORM TO FAECAL STREPTOCOCCI RATIOS IN THE DIFFERENTIATION OF FAECAL POLLUTION SOURCES,
Hydrological Research Inst., Pretoria (South Africa).
P. A. E. Rosser, and D. P. Sartory.
Water S. A., Vol 8, No 1, p 66-68, January, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Chlorinatiion, *Sewage bacteria, Bacteria, Coliforms, Streptococci, Wastewater treatment, Disinfection, Microbiological analysis, Water pollution sources, Effluents, Secondary wastewater treatment, Feces.

Data are presented on the effect of chlorination of purified sewage effluents on fecal coliform (FC):fecal steptococci (FS) ratios. Samples were routinely collected over a period of six months from the sewage works northeast of Pretoria, covering periods before and after commencement of chlorination of the effluent. Secondary purified unchlorinated sewage effluent samples were also collected from this sewage works for study. Results indicate that fecal streptococci are more resistant to chlorination than are fecal coliforms. This greater resistance to chlorine by fecal streptococci results in a significant lowering of the FC:FS ratio following chlorination of purified sewage effluents. When purified effluents are chlorinated, greatly reduced FC:FS ratios are recorded, in some cases indicating animal fecal pollution from a domestic sewage source. Thus the indicative power of the PC:FS ratio to differentiate pollution types is abrogated. Under present circumstances, where even small scale sewage works chlorinate their effluent, the use of the FC:FS ratio to predict fecal pollution type must be treated with great caution. (Baker-FRC)
W82-05902

WASTEWATER REUSE USING MICROGRAS DISPERSION STRIPPING,
Shaler (Amos J.), Inc., State College, PA.
A. J. Shaler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243353, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-81/4, May 1981. 180 p, 29 Fig, 46 Tab, 35 Ref, 4 Append. OWRT-C-802620-R(8807)(1).

Descriptors: *Water reuse, *Flotation, *Wastewater treatment, *Industrial wastewater, Water quality control, *Water pollution prevention, Industrial development, Process control, Industrial wastes, Water treatment, Design criteria, Water quality, Pollutants, Water pollution treatment, Environmental control, Water pollution sources, Liquid wastes, Wastewater management.

Investigation was made of micro gas dispersion (MGD) flotation of heavily-loaded complex wastewaters, a new flotation process, which focused on wastes from an industrial laundry since they represented the kinds of mixed contaminations found in wastes from the laundry's industrial clients. Wastewaters from some client plants and from nonlaundry clients which produce simpler but more heavily-laden wastewaters were also studied. The overall investigation sought to produce a recyclable effluent. All wastewaters were successfully clarified in two flotation steps. This process (tested in test-tube batteries, separating funnels, and in a two-column test stand) included automatic pH correction, flotation with an MGD, a second pH correction, and a second MGD flotation. Optimum composition of the MGDs were sought. The successful MGDs contained 40-60% air by volume, water which became recycled, about 100 ppm of surfactants, and about 1000 ppm of a flocculant. For industrial laundry wastewaters, non-metallic contaminants were reduced from thousands of ppm at removal ratios of 3-275 (67-99.6% removal); metallic constituents were reduced from up to 25 ppm at ratios up to 10,000 (99.99% removal). Wastewaters from other sources were generally more easily clarified. (Zielinski-MAXIMA)
W82-05911

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
P. B. Belt, T. W. Joyce, and H-M. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243379, Price codes: A06 in paper copy, A01 in microfiche. Report No 175, November 1981. 97 p, 12 Fig, 25 Tab, 71 Ref, 5 Append. OWRT A-116-NC(1), 14-34-0001-0135.

Descriptors: *Pulp washing, Pine trees, *Chlorination, *Bleaching wastes, Pulp and paper industry, Kraft mills, *Pulp wastes, Industrial wastes, Chlorine, Pollutants, Water pollution sources, Water pollution control, Effluents, Tensile strength, Environmental control, Water quality control, *Wastewater treatment.

The strength and effluent characteristics of variously bleached southern pine kraft pulps were assessed. High-brightness pulps were produced in sequences of chlorination (C), alkaline extraction (E) and chlorine dioxide (C) treatment, with/without oxygen pre-bleaching. Sequences used were CEDED (conventional bleaching) and CED (oxygen pre-bleaching), with first-stage sequential chlorine dioxide substitution. Effleunts from the various stages were tested for BOD, COD, color, chlorides, mutagenicity and Daphnia toxicity. sim-

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ulated whole mill effluents for each sequence were applied to bench-scale aerated lagoons to assess their biological treatability in a conventional wastewater treatment system. The results indicated that substantial pollutant output reductions can be achieved by use of oxygen bleaching and total recycle of the oxygen stage effluent: Use of D in the first stage chlorination had little effect on BOD and COD. Effluents from the aerated lagoon were non-toxic and non-mutagenic. The results of pulp strength tests indicated that oxygen pre-bleaching successfully produces a high-brightness pulp with strength characteristics similar to that produced by conventional bleaching sequences. (Zielinski-MASIMA)
W82-05913

UV DISINFECTION FOR ONSITE SAND FILTER EFFLUENT,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and S. Romatzick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243601, Price codes: A03 in paper copy, A01 in microfiche. May, 1982. 32 p, 11 Fig, 1 Tab, 9 Ref. OWRT A-051-ME(1).

Descriptors: *Disinfection, effluents, *Sand filters, *Wastewater treatment, *Ultraviolet disinfection, Cost analysis, *Cost comparisons, Feasibility studies.

The technical and economic feasibility of using ultraviolet (uv) light as a viable alternative to chlorine as the required disinfectant for onsite sand filter effluents discharged to surface waters in Maine was determined. To obtain a reliable cross section of performance for sand filters in Maine, 74 filters were selected for an effluent characterization program. The effluent characterization study allowed general conclusions to be made with regard to the potential of uv disinfection. A simple suspended lamp uv disinfection unit was designed, constructed, and tested in the laboratory and in the field. The efficiency of the uv disinfection unit was determined through field testing at 10 of the 74 sand filter sites used in the effluent characterization program. The 10 test sites accurately reflected the broad spectrum of effluent quality that exists in the field, ensuring that the results of the study would be generally applicable to all sand filters. Performance testing demonstrated that the suspended lamp disinfection unit is capable of nearly complete disinfection for fecal coliform over the range of effluent quality which exists in the field. An economic comparison of the uv unit vs. the tablet chlorinator demonstrated that the initial equipment costs for the two systems are approximately equal; however, the annual operating cost for the uv unit is less than for the tablet chlorinator. In addition, the maintenance requirements and potential field problems were estimated to be far fewer than those associated with a tablet chlorinator. (Author abstract)
W82-05937

WASTE TREATMENT SYSTEM RETROFITTED WITHIN DEADLINE,
B. B. Hall, T. L. Shepard, and P. A. Peterson.
Power Engineering, Vol 86, No 5, p 58-59, May 1982. 1 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Electric powerplants, *Chemical treatment, Effluent limitations, Coal, Chemical precipitation, Settling basins, Air pollution, Fly ash, Filtration, Vacuum filters, Weirs, Wastewater facilities, Waste disposal, *Minnesota.

In 1975, the Minnesota Pollution Control Agency issued a permit authorizing the wastewater discharges from the Fox Lake power station of the Interstate Power Company in accordance with the limitations of the Federal Water Pollution Control Act. In 1979, Litz, Daily and Brain studied the discharge requirements of the power plants practical and economical way to handle wastes. It was decided that a new treatment facility costing over $1.5 million would be fully retrofitted by March 1981. Under the new system, each waste stream will be handled separately. Dry flyash handling was recommended for potential resale to concrete mix plants, while treatment of boiler blowdown and air heater washwater is carried out by chemical precipitation and filtration in batch treatment. After precipitation, the wastewater is pumped from an equalization basin to a diatomaceous earth precoat vacuum filter which combines other miscellaneous wastes before discharge to the lake. Diversion channels were constructed around the coal storage area to collect rainfall runoff, while a retention basin was provided for the settling of suspended solids from the runoff. An overflow weir was included at the outlet of the basin to regulate the discharge and control the carryover of coal fines. (Geiger-FRC)
W82-05947

NITROGEN REMOVAL IN CONTINUOUS-FLOW SEQUENTIALLY AEREATED ACTIVATED SLUDGE SYSTEMS,
State Pollution Control Commission, Sydney (Australia).
M. C. Goronszy, and D. Barnes.
Process Biochemistry, Vol 17, No 1, p 13-19, January/February, 1982. 5 Fig, 4 Tab, 36 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrification, *Wastewater treatment, Nitrogen removal, Aerobic conditions, Anaerobic conditions, Dissolved oxygen, Nitrates, Oxygen uptake, Organic loading, Ammonia, Aeration, Temperature effects.

A 3-year study on nitrogen removal in full scale continuous activated sludge systems used intermittent aerobic-anoxic conditions and domestic wastewater as a carbon source and electron donor. The plant operated in four 6-hour cycles. Mean total N. removals were greater than 85%, with most off the residual N in the organic form; residual ammonia-N was zero or nearly zero. Temperatures below 10 C reduced removal efficiencies by about 10%. When the dissolved oxygen concentrations present during the aerobic sequence (optimum 4 mg per liter) were adjusted to the applied organic load, anoxic conditions were maximized. In a conventional system using methanol and a sludge with a denitrification rate of 12 g nitrate N per g MLSS per day at 25 C, an anoxic retention time of 2 hours (of the 6 hour cycle) was necessary to denitrify 25 mg per liter of Nitrate in 24 hrs. In the continuous feed sequential system a total of 28 g of oxidized N can be denitrified every 24 hours during the anoxic sequence with a food/microorganism ratio of 0.05 and an average denitrification rate of 0.03 kg nitrate-N per kg MLSS per day. Additional denitrification occurs during the aerobic sequence for a total of 35 mg per liter per day. (Cassar-FRC)
W82-05950

SOLVING A POOR OXYGEN TRANSFER PROBLEM.
Public Works, Vol 113, No 5, p 88, May, 1982.

Descriptors: *Oxygen transfer, *Aeration, *Wastewater treatment, Energy, Diffusers, Montecito, *California, Cost analysis.

An investment of $17,000 saved $19,000 in energy costs the first year at the Montecito, California, wastewater treatment plant. The extended aeration plant receives somewhat more than its 0.75 mgd capacity. As a result adequate dissolved oxygen was hard to maintain in the reactors during 1978-79. The existing 392 coarse bubble diffusers were replaced with FMC Corporation SP35 Pearlcomb fine bubble diffusers. In addition to saving energy costs for blower operation, blower wear has been reduced and clogging of diffusers has been eliminated. (Cassar-FRC)
W82-05952

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,
Eco-Research Ltd., Inc., Point-Claire (Quebec).
S. M. Shere, and P. G. Daly.
Pulp and Paper Canada, Vol 83, Convention Issue, p 62-66, March, 1982. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Pulp and paper industry, *Biological treatment, *Toxicity, Fish, Trout, Mortality, *Wastewater treatment, Industrial wastewater, Mixing, Oxygenation, *Thermomechanical pulping process, *Pulp wastes.

Wastewater from the thermomechanical pulping process (TMP) was treated biologically in a laboratory aerobic fermenter using high oxygen concentrations (above 3 mg per liter) and rapid mixing (900 rpm and Reynlds number greater than 100,000). The pH and temperature were maintained at 7.0 and 30 C, respectively. Total BOD removal was 96% at food/microorganism ratios of 0.9-1.7 per day and 74% at ratio of 3.6-4.5. Total COD removals were 80% amd 61%, respectively. Raw wastewater contained 1000 mg per liter total BOD and 2650 mg per liter total COD. In toxicity tests juvenile rainbow trout suffered 100% mortality when exposed to 18% influent for 96 hours. No mortality was seen in fish exposed to 100% effluent for the same time. (Cassar-FRC)
W82-05955

COPPER REMOVAL BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, and E. L. Thackston.
Separation Science and Technology, Vol 17, No 2, p 359-367, 1982. 1 Fig, 7 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Copper, Heavy metals, Industrial wastes, *Metal-finishing wastes, Metals, Colloids, Adsorption, Separation techniques, Recycling, *Foam separation, *Flotation.

A project was designed to test the foam flotation process on metal plating wastes. The results obtained by a large continuous flow pilot plant treating a simulated copper-bearing waste are presented. Ferric chloride was added to the wastewater to form a ferric hydroxide precipitate which acted as the adsorbent in the adsorption process. Adjustment of the pH was accomplished using sodium hydroxide, and sodium lauryl sulfate was the surfactant. Simulated copper bearing wastewaters were prepared by dissolving copper sulfate in tap water, then adjusting the pH to prevent the precipitation of copper carbonate. The variables having an influence on the efficiency of the system which were studied are pH, Fe(III) and sodium lauryl sulfate concentrations, wastewater hydraulic loading rate, ionic strength, and air flow rate. At pH values higher than 7.4, the decrease in flotation efficiency leads to the presence of some ferric hydroxide in the effluent. The optimum Fe(III) concentration seems to be between 90 and 100 mg/liter. For sodium lauryl sulfate the concentration of 15 mg/liter seemed sufficient to maintain a good, stable foam pattern in the column. Increasing the hydraulic loading rate let to a decrease in copper removal efficiency. Air flow rates of 11 to 13 nitrogen cubic meters/square meter/hour were sufficient to provide a good performance of the flotation column. Increasing ionic strength has a negative influence on the treatment efficiency. Good results were achieved up to 0.5 M sodium chloride concentrations. The results indicate that sodium lauryl sulfate recovery from the foamate and recycling back to the system are possible after sodium hydroxide treatment. (Baker-FRC)
W82-05960

RECOVERY OF FINE-PARTICLE COAL BY COLLOID FLOTATION,
Ohio State Univ., Columbus. Water Resources Center.
A. J. Rubin, and R. J. Kramer, III.
Separation Science and Technology, Vol 17, No 4, p 535-560, 1982. 11 Fig, 35 Ref.

Descriptors: *Coal, *Flotation, *Mine wastes, *Colloids, Bubbles, *Wastewater treatment, Surfactants, Wash water.

Colloid flotation was applied to removal of extremely small coal particles from wash water prior

to discharge into receiving waters. The process used micro-bubbles generated at low nitrogen gas flow rates. Oxidized coal particles had greater negative mobility and an isoelectric point at a lower pH than unoxidized coal. Hexadecyltrimethylammonium bromide (CTAB), a cationic surface collector, successfully adsorbed the negatively charged coal particles. Sodium lauryl sulfate, an anionic surfactant, was ineffective in flotation. At CTAB doses of 10 mg per liter and less, foaming was poor, especially at higher pH. At 25 mg per liter CTAB foam was stable at all pH. The pH, gas flow rate, and frother (ethanol) dose were varied to study the effects of these parameters on flotation. Rates of removal were greatest at low pH. At 60 min recoveries were 80-90% at pH 1.52 and 2.50, 20-25% at pH 5.35 and 8.50. At pH 3.50 an irregular removal pattern occurred, with eventual 90% removal. Foaming was maximum at pH 1.52 and 2.50, absent at 5.35 and 8.50, and slow to form at pH 3.50. Greater gas flow rates improved coal removal. Recovery was 100% in 20 min at 62 ml per min, 100% in 50 min at 31 ml per min, and 80% in 60 min at 16 ml per min. Varying the doses of frother showed that 100% removal was attained in 25 min at 1.71 ml per 400 ml coal suspension, in 50 min at 0.95 ml, and at > 80 min a 0.44 ml. No foam formed with 0.29 ml frother. (Cassar-FRC)
W82-05961

REMOVAL OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING MICROGAS DISPERSIONS,
Rhode Island Univ., Kingston.
S. Ciriello, S. M. Barnett, and F. J. DeLuise.
Separation Science and Technology, Vol 17, No 4, p 521-534, 1982. 7 Fig, 3 Tab, 12 Ref.

Descriptors: Metals, *Metal-finishing wastes, *Flotation, *Heavy metals, Chromium, Nickel, Copper, Lead, Zinc, Iron, *Wastewater treatment, Industrial wastewater, Bubbles, Chitosan, Chelation, Surfactants, Jewelry industry, *Microgas dispersions.

Batch flotation using microgas dispersions was used to remove heavy metals from individual solutions and from industrial plating effluents. Either ethylhexadecyldimethylammonium bromide or sodium dodecylbenzene sulfonate at 300 ppm was used to prepare the bubble structure. Removal was highest in the pH range 6-10, depending on the metal. Initial concentrations and % removals from individual solutions were; Cu, 8.46ppm, 100%; Ni, 19.50 ppm, 98.5%; Zn, 18.11 ppm, 95.1%;Cr, 10.10 ppm, 26.7% and Pb, 10.92 ppm, 79.1%. In a synthethic mixed metal wastewater containing about 10 ppm each of Cu, Ni, and Zn, 3.80 ppm of Cr, and 0.233 ppm Pb, removals were 95-98% for Cu, Ni, and Zn, 20.8% for Cr, and 100% for Pb. In a wastewater effluent from a plating plant with 0.1-2.6 ppm each, Cu, Ni, Fe, Cr, and Zn removals were 14.1-84.5%. Chitosan improved removals to 50.9-100% in another sample containing 0.2-3.9 ppm each of Cu, Ni, Fe, Cr, and Zn. Reducing hexavalent Cr to the trivalent state using sodium sulfite produced removal efficiencies of > 90% for all 5 metals tested (Cu, Cr, Ni, Zn, and Pb). (Cassar-FRC)
W82-05962

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, and W. G. Leseman.
Transactions of the ASAE, Vol 25, No 2, p 381-387, March/April, 1982. 9 Fig, 9 Tab, 15 Ref.

Descriptors: *Land application, *Wastewater irrigation, *Groundwater pollution, Fate of pollutants, Wastewater disposal, Land disposal, Municipal wastewater, Wastewater treatment, Tallahassee, *Florida, Nitrates, Soil disposal fields, Grasses, Nutrients, Hydrogen ion concentration, Potassium, Sodium, Calcium, Magnesium, Phosphorus.

Municipal wastewater effluent from the Tallahassee, Florida, treatment plant was applied to sandy soil planted to various grasses. The appplication was started in 1966. The characteristics of wastewater, soil, and groundwater were measured starting in 1971. Essentially all suspended soils, BOD, fecal bacteria, and phosphorous were removed by the soil. Water in a field well had an average pH of 7.7, 49 mg per liter chloride, and 18.6 mg per liter N (mostly nitrate) compared with the background well water of 8.3 pH, 2 mg per liter chloride, and < 1 mg per liter nitrate. The 31.3 mg per liter total N in the effluent was reduced to 1816 mg per liter by bacterial reduction and plant uptake. The coastal bermuda grass plot removed more N from the effluent than the plot with mixed vegetation. Ca passed through the soil unchanged. K was removed by the crop. Soil pH (5.8-6.3) was essentially constant with depth and intermediate between background soil of pH 5.5 and effluent of pH 7.5. The sum of extractable bases decreased with depth, exchangeable K and Na were constant with depth, and Ca and Mg decreased slightly with depth. At an irrigation rate of 20 cm per week, nitrate entered the groundwater, exceeding the drinking water standard of 10 mg per liter. (Cassar-FRC)
W82-05964

CARBON-DIOXIDE NEUTRALIZATION OF AN ALKALINE EFFLUENT,
Diamond Shamrock Corp., Muscle Shoals, AL.
M. J. Griffith, and D. B. Burgener.
Industrial Wastes, Vol 28, No 2, p 18, 24-45, March/April, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Neutralization, *Carbon dioxide, Design criteria, Effluent streams, Alkalinity, Industrial wastewater, Alabama.

A chloralkali plant in Muscle Shoals, Alabama, located on a 60 acre site adjacent to the Tennessee River has been converted from a manually controlled sulfuric acid pH control system for neutralizing the effluent to an automatic carbon dioxide process which is engineered to treat the caustic plant effluent before releasing it into the nearby river. The control system has allowed the plant to reduce the pH of 17 mgd of wastewater from a maximum of 11.75 down to 8.3, well within the 6.0 to 9.0 pH limits. This was done at lower cost than with a conventional acit treatment system. The availability of carbon dioxide, particularly during the winter months, was one factor influencing the decision, as the system had to operate continuously. The only disadvantage of using carbon dioxide is that it tends to lower the dissolved oxygen content to about 4.5% at the point of injection; this is not considered a problem in this application. The plant uses a unique sidestream pH control system to reduce the amount of carbon dioxide lost to the atmosphere by mixing a small volume of highly carbonated water with the remaining effluent flow. Since the pH is controlled with a supersaturated carbon dioxide-water solution, there is little of this gas being released from the discharge manifold into the effluent stream, and thus losses are negligible. The sidestream injection manifold is probably the simplest and most important component of the entire system. Extensive laboratory and on-site testing were performed to determine the direction, size and layout of the 20 removable orifices on the manifold. The system has performed in accordance with design parameters since its installation in 1978. (Baker-FRC)
W82-05973

COMMON FACILITY TREATMENT OF INDUSTRIAL WASTEWATERS,
Gulf Coast Waste Disposal Authority, Houston, TX.
J. P. Teller.
Industrial Wastes, Vol 28, No 2, p 26-28, March/April, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, Design criteria, Secondary wastewater treatment, Activated sludge process, *Texas.

The Gulf Coast Waste Disposal Authority concentrates on the disposal of wastewater, both municipal and industrial, and on the disposal of industrial solid wastes. The range of authority spans three counties, Chambers, Galveston, and Harris. Wastes from various sources are combined in different ways but treated at the same facility. In addition to industrial wastes the authority operates 26 municipal plants, seven of which are centralized for joint treatment. A case history of the Washburn Tunnel Facility is presented as an example of the process of developing a joint waste treatment program. The advantages of the joint approach to treatment include tax-free capital investment, ad-valorem tax exemption, sales tax-free purchases, savings in chemical costs, and the elimination of multiple laboratory functions. At the Washburn Tunnel Facility secondary treatment is provided for up to 52 mgd. This represents one-third of the industrial biological demand produced by Houston Ship Channel Industries. The activated sludge process removed 95% of the biochemical oxygen demand and 90% of suspended solids coming into the plant. Organic pollutants are brought into contact with bacteria and converted to harmless carbon dioxide, water and more bacteria. Regional waste treatment faciliies can work and yield a cost effective program for joint industrial waste treatment through careful planning and attention to detail. (Baker-FRC)
W82-05974

WASTEWATER TREATMENT AT AN ELECTRICAL GENERATION STATION,
Illinois Power Company, Decatur.
R. W. Walden.
Industrial Wastes, Vol 28, No 2, p 14-17, March/April, 1982. 1 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Electric power production, Hydroelectric power, Industrial wastes, Effluents, Water quality, Aeration, Chlorination, Ponds, Lagoons, Powerplants, *Illinois, Regulations.

The plan used by the Illinois Power Company in achieving compliance with water pollution control limitations revolves around the combining of various wastewater streams at coal burnign sites. For example, fly ash sluice waters and certain plant wastewaters have flocculation properties which aid in the cleanup of other wastewater streams when all are joined within the ash pond system. Other benefits of this approach include the operation of a complete water analysis laboratory, the minimum use of remote monitoring and control equipment needed for compliance, and the resulting cost effective installation, operation and maintenance methods associated with water pollution control efforts. The ash pond system was designed to include a majoy collection pond followed by two clarification ponds in series to control total suspended solids. A former sanitary treatment facility was replaced by an extended aeration system such that the sanitary effluent regularly satisfies the limits of 30 ppm for BOD-5, 30 ppm total suspended solids, 200 counts per 100 ml for fecal coliforms, 0.75 ppm for total chlorine residual and pH range of 6 to 9. The original units at the Havana Power Station, adjacent to the Illinois River system, have once-through river water cooling condensers. At the powerplant, a small portion of the low sulfur fly ash generated tends to float. Most of it is trapped in the first two ponds and appears as a white substance around pond shorelines. A carbon dioxide system has been installed for controlling ash pond pH during temporary excursions in plant operations. (Baker-FRC)
W82-05975

VERIFICATION OF A MODEL FOR FOAM FLOTATION COLUMN OPERATION,
Vanderbilt Univ., Nashville, TN.
J. E. Kiefer, J. Rodriguez, G. McIntyre, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 3, p 453-563, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Model studies, Surfactants, Effluents, Foam separation, *Wastewater treatment, *Foam flotation.

Experimental data were collected during testing of the validity of a mathematical model for the time-

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dependent operation of a continuous flow floating column for industiral wastewater treatment. The surfactant being removed was sodium lauryl sulfate (NLS). A comparison was made of the responses of the column in steady-state operation and under the influence of rectangular pulses in terms of NLS concentration and of hydraulic loading rate with the results of computer simulation. Under all conditions effluent surfactant concentrations were well simulated. The fraction of liquid in the Plateau borders varied somewhat with the hydraulic loading rate, thus causing some discrepancy between calculated and observed collapsed foamate flow rates. It is noted that for a model which describes the column operation exactly, one must develop an expression for the fraction of liquid in the Plateau borders which depends on factors such as the total liquid fraction and the particulate concentration. Since effluent concentration is almost independent of this parameter, this expression is not needed to make the model useful as presented in this paper. Another addition which would improve the model would be to account for the mixing in the liquid pool below the air disperser. Such a change would allow one to predict more accurately the effluent concentration as a function of time as the influent conditions are abruptly changed. (Baker-FRC)
W82-06001

IMMOBILIZED MICROBES AND A HIGH-RATE, CONTINUOUS WASTE PROCESSOR FOR THE PRODUCTION OF HIGH BTU GAS AND THE REDUCTION OF POLLUTANTS,
Corning Glass Works, NY. Research and Development Labs.
R. A. Messing.
Biotechnology and Bioengineering, Vol 24, No 5, p 1115-1123, May, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Anaerobic digestion, *Methane bacteria, *Porous media, Ceramics, Wastewater treatment, *Biological treatment, Bacteria, Carbon dioxide.

A very efficient reactor for anaerobic digestion of sewage was based on microbes densely packed within the pores of controlled-pore ceramics. Some of the ceramic materials used were extruded Cordierite (pore diameter, 1-9 microns), Duralite Noire extruded brick (pore diameter 0.8-30 microns), and insulating firebrick (pore diameter 2-15 microns). Pore volumes were 0.29-1.0 cu cm per g. Laboratory-scale two-stage reactors consisted of the vertically mounted hydrolytic-redox stage, which reduced the size of the waste molecules (cellulose, protein), and the horizontally mounted anaerobic digestion stage, which converted the small molecules of carbon dioxide, acetic acid, etc. to methane. These reactors have operated continuously for 2 years, efficiently converting carbon to methane. The reactors were operated at 20, 30, and 40 C for residence times of 2-5.5 hours. Total COD of the sewage was 800-2600 mg per liter. 32-54% of the influent carbon was recovered as methane, and total COD reduction was 63-89%. The resulting gas was 90% methane and < 5% CO2. (Cassar-FRC)
W82-06005

MODIFIED SLUDGE DIGESTION WITH IMPROVED GAS YIELD (MODIFIZIERTE SCHLAMMFAULUNG MIT VERBESSERTER GASAUSBEUTE),
Wasser, Luft und Betrieb, Vol 26, No 1/2, p 24-25, 1982. 1 Fig. (No English summary).

Descriptors: *Sludge digestion, *Anaerobic digestion, *Energy conversion, Heat exchangers, *Wastewater treatment, Biodegradation, Biological treatment, Costs, Pendulum mixer, Zenith-Biomax system.

A modified system of anaerobic alkaline sludge digestion, the Zenith Biomax, is described. The system seeks to reduce energy costs as well as investment and maintenance costs and allows for the addition of prepasteurization capabilities. The heat supply is built exclusively on external heat-exchanger systems. The system is equipped to allow loading of fresh sludge to correspond to energy demand, resulting in maximal energy yield. The Biomax system is also capable of enabling the user to calculate energy demand in advance. A special method of turning the digestion tank, which is highly significant with regard to gas yield and digestion time, was developed: the Zenith pendulum mixer. This provides a settling and thickening zone in the bottom area of the digestion tank. Through the centrifugal effect in the turning zone the sedimentation of mineralized substances is markedly improved, and the proportion of mineralized substances in the end product greater. A further advantage of the pendulum mixer is that movement in the main sluice runs from bottom to top. This must be reversed occasionally for technical reasons, and the dual tangential outflow results in rotation of the tank. This effect is used in the separation of floating sludge, which can be done several times daily without significantly impairing gas production. An optimal bacterial culture in the upper area of the tank and easier gas extraction is also achieved by using the pendulum mixer. The Biomax system can improve gas yield by up to 30%. Further utilization of this gas will be economically feasible in larger plants. (Gish-FRC)
W82-06024

DOMES, BUBBLES, AND PAPER WASTE,
Badger Paper Mills, Inc., Peshtigo, WI.
R. Kinzel, and H. Rushton.
Water/Engineering and Management, Vol 129, No 4, p 47-48, April, 1982.

Descriptors: *Pulp and paper industry, Aeration, *Bubbles, *Wastewater treatment, Industrial wastewater, Badger Paper Mills, Peshtigo, Wisconsin, Activated sludge process.

The Badger Paper Mills, Inc., built a 6 mgd wastewater treatment plant for joint use by the mill and the town of Peshtigo, Wisconsin. This system replaced a mechanically aerated 2-lagoon plant. The new treatment plant incorporated a dome diffusion aeration system, which generates fine bubbles from porous ceramic diffuser domes equally spaced on the floors of the concrete basins. The plant receives 95% of its waste load from the paper mill and 5% from municipal sources. Power costs have been reduced 35-40% and detention time by 14 days compared with the lagoon system. The concrete basins required only one-fourth the land area taken by the lagoons. Splashing, spray cooling, and winter freezing, frequently problems in the lagoon operation, have been eliminted. Sludge is more easily dewatered. (Cassar-FRC)
W82-06025

REMOVAL OF HEAVY METALS FROM ELECTROPLATING RINSEWATERS BY PRECIPITATION, FLOCCULATION AND ULTRAFILTRATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and J. T. Delwiche.
Water Research, Vol 16, No 5, p 729-737, May, 1982. 6 Fig, 8 Tab, 15 Ref.

Descriptors: Metals, *Electroplating, Industrial wastewater, *Wastewater treatment, Metal-finishing wastes, *Heavy metal, Chemical precipitation, *Flocculation, *Filtration, *Ultrafiltration, Chromium, Copper, Zinc, Nickel, Cyanides, Sodium hydroxide, Iron compounds.

Heavy metals were effectively removed from four separate electroplating rinsewaters by precipitation, flocculation, and ultrafiltration. Hexavalent Cr was first reduced to the trivalent state with ferrous sulfate and then precipitated with NaOH. Ni rinsewaters were treated with NaOH and FeC13 and again with NaOH. Cyanides in Cu and Zn rinsewaters were oxidized with NaOCl before precipitation of the hydroxides with FeCl3 and NaOH. Filtration through a plate-and-frame ultrafiltration apparatus with acrylic membranes of 0.20-.80 micron pore size reduce the effluent metal concentrations (mg per liter) to 0.17 (trivalent Cr), 0.26 (Ni), 0.30 (Cu), and 1.84 (Zn). Water recoveries (the fraction of the feed stream that permeates the membrane) were: Ni,24%; Cr. 10%; Cu, 6.5% and Zn, 3.7%. High water recoveries were associated with the maximum volume of filtered water in a given time and at a given pumping power. The metal levels were in good agreement with theoretical solubility curves, except for Cu, where the formation of stable Cu cyanide complexes appears to increase the solubility by 2 orders of magnitude over the solubility predicted from equilibrium constants for copper hydroxides and oxides. (Cassar-FRC)
W82-06029

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06030

EFFECT OF CHEMICAL COAGULATION ON ANAEROBIC DIGESTIBILITY OF ORGANIC MATERIALS,
Cornell Univ., Ithaca, NY. Dept of Environmental Engineering.
S. K. Dentel, and J. M. Gossett.
Water Research, Vol 16, No 5, p 707-718, May, 1982. 14 Fig, 5 Tab, 36 Ref.

Descriptors: *Sludge digestion, *Coagulation, *Organic matter, *Wastewater treatment, Digestion, Alum, Ferric chloride, Anaerobic digestion, Proteins, Carbohydrates, Acids, Organic acids, Amino acids, Chemical reactions, Phosphates, Biodegradation.

Chemical coagulation of wastewater with alum or ferric chloride reduced the biodegradability of sludges in anaerobic digestion. This paper investigated different substrates: raw wastewater, activated sludge, three proteins (gluten, ovalbumin, and zein), glycine, cellulose, glucose, butyric acid, and palmitic acid. In general, the sludges from the less water-soluble substrates and the substrates containing readily ionizable groups were most adversely affected. This group included amino acids, proteins, and long chain fatty acids, but not glucose and butyric acids. Cellulose was moderately affected, suggesting that physical enmeshment may be a factor. The observed coagultion effects were distinct from any effects of increased loading or differences in pH or alkalinity and were not attributable to toxicity, increased fixed solids concentrations, or phosphate limitation. Smaller particles were less easily digested than larger, settleable particles. During the flocculation process the organic substrate is enmeshed in the floc, rendering it less susceptible to digestion. Chemical interactions also may affect digestibility. (Cassar-FRC)
W82-06039

PRODUCT INHIBITION IN THE ACID FORMING STAGE OF THE ANAEROBIC DIGESTION PROCESS,
Amsterdam Univ. (Netherlands).
R. J. Zoetemeyer, A. J. C. M. Matthijsen, A. Cohen, and C. Boelhouwer.
Water Research, Vol 16, No 5, p 633-639, May, 1982. 5 Fig, 8 Tab, 19 Ref.

Descriptors: *Anaerobic digestion, *Inhibition, *Acids, *Wastewater treatment, Volatile acids, Butyric acid, Organic acids, Fatty acids, Organic compounds, Glucose, Nutrients, Kinetics, Chemical reactions, Biodegradation, Sulfates, Carbonhydrates.

Inhibition of the anaerobic digestion process by formation of volatile fatty acids was studied using glucose as a carbon source and a complete nutrient medium to ensure carbon limitation. Glucose monohydrate concentrations were 2.5, 5, 10, 30, 50, and 75 g per liter. The main products (butyrate, acetate, and lactate) increased with increasing glucose concentrations; ethanol and propionate were fairly constant; formate was < 10 ppm C. Product recoveries averaged 90%. Yields decreased from 16-19% at lower concentrations to 9-10% at higher glucose concentrations. Maximum dilution rates

changed from 0.46 at the lowest glucose concentrations to 0.04 at the highest. A relationship was observed between maximum dilution rate and log of concentration of acids produced. At a constant glucose input concentration of 10 g per liter inorganic nutrients were increased from 1 to 5%. No reaction inhibition occurred during gradual nutrient increases, but sudden large changes caused reactor failure. Sulfate reduced to sulfide at sulfate concentrations > 140 ppm, but no inhibition was noted. Addition of 1100 mg C per liter butyrate to the reactor decreased butyrate and propionate production and increased lactate production. At higher butyrate influent levels, glucose appeared in the effluent, a small amount at 1700 mg C per liter butyrate dose and large amounts at 2500 mg C per liter. The reactor returned to a steady state after 3 days. (Cassar-FRC)
W82-06041

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
L. Brown, M. M. Rhead, D. Hill, and K. C. C. Bancroft.
Water Research, Vol 16, No 5, p 579-591, May, 1982. 1 Fig, 9 Tab, 20 Ref.

Descriptors: *Acrylamide, *Organic compounds, *Toxicity, Water pollution effects, Fate of pollutants, Activated sludge process, Biological treatment, Invertebrates, Aquatic fauna, Insects, Species diversity, Acclimatization, Wastewater treatment, Biodegradation, Degradation, Adsorption.

Acrylamide, a toxic monomer, was added to an activated sludge sewage works, a biological filter sewage works, and a river during the period October 1979 to July 1980. Little in situ degradation of acrylamide occurred in the primary or final settlement tanks in either sewage plant. However, the high microbial activity in the activated sludge tanks and in the biological filter beds reduced the acrylamide by 50-70%. In another study acrylamide was dosed into a stream for 74 days. No in situ loss of acrylamide by degradation or adsorption occurred within 4-5 hours. There was an apparent slight increase in degradative ability of the micro-organisms with long-term exposure to acrylamide. The insect fauna in the river showed reduced species diversity and population size within 5 hours of dosing to 50 micrograms per liter acrylamide. After a week's exposure only Hydropsche instabilis did not suffer adverse effects or total elimination. Several species recolonized within 4 to 8 weeks after the final acrylamide dose. (Cassar-FRC)
W82-06044

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,
Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, J. A. Veil, and J. T. Canaday.
Water Research, Vol 16, No 5, p 543-550, May, 1982. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Microscopic analysis, *Microorganisms, *Biological treatment, *Wastewater treatment, *Rotating biological contactors, Bacteria, Beggiatoa, Desulfovibrio, Biofilms, Sulfides, Sulfur bacteria, Filamentous bacteria, Heterotrophic bacteria, Anaerobic bacteria, Aerobic bacteria.

A rotating biological contactor biofilm from a treatment facility in Alexandria, Virginia, was examined by scanning electron microscope to characterize the nature of filamentous surface growth. Layers of morphologically diverse microorganisms were found. The white surface layer was composed of a dense interwoven mat of bacterial filaments, dominated by Beggiatoa . The black lower layer contained straight and comma-shaped rods dominated by Desulfovibrio, a sulfide producing bacteria. The black color is believed to be a ferrous sulfide deposit. The sulfide diffuses toward the surface layer and serves as an energy source for the Beggiatoa. The filamentous growth is a symptom of reduced oxygen availablility and high substrate loadings. (Cassar-FRC)
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
R. J. Larson, and S. L. Schaeffer.
Water Research, Vol 16, No 5, p 675-680, May, 1982. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Activated sludge process, *Toxicity, *Inhibition, Wastewater treatment, Water pollution effects, Mercury, Sodium azide, Hypochlorites, Dichlorophenol, Phenols, Trimethylammonium chloride, Organic compounds, Sodium hypochlorite.

Toxicity of chemicals to activated sludge was determined by measuring inhibition of C14-labeled glucose uptake after 15 min. The IC50 value (the concentration of chemical inhibiting uptake by 50%) was determined by nonlinear regression analysis of the decrease in glucose uptake as a function of the log of test chemical concentration. Uptake in the presence of both inorganic and organic chemicals showed significant dose-dependent decreases as the concentration of test material increased. Some IC50 values (in mg per liter) were: 3,5-dichlorophenol, 13.4; alkyl trimethyl ammonium chloride, chain length, C14-C18, 28.4; hypochlorite, 20.0; and sodium azide, 1041.8 (essentially nontoxic to sludge). IC50 for Hg(++) depended on the level of volatile suspended solids, decreasing from 6.1 to 1.6 mg per liter with a four-fold dilution. The results obtained in this study agreed with values from previous studies on materials which adversely affect wastewater treatment processes. (Cassar-FRC)
W82-06048

EFFECT OF MAGNESIUM AND CALCIUM PRECIPITATION ON COAGULATION-FLOCCULATION WITH LIME,
Ministry of Transport and Public Work, Middelburg (Netherlands). Environmental Research Div.
J. Leentvaar, and M. Rebhun
Water Research, Vol 16, No 5, p 655-662, May, 1982. 10 Fig, 5 Tab, 10 Ref.

Descriptors: *Lime, *Magnesium hydroxide, *Coagulation *Wastewater treatment, *Calcium hydroxide, Chemical precipitation, Flocculation, Adsorption, Organic matter, Organic carbon.

Two major mechanisms were demonstrated in coagulation-flocculation of sewage with lime-magnesium hydroxide treatment: (1) sweep coagulation by calcium carbonate and (2) adsorption-coagulation of stable organic colloids by magnesium hydroxide. On the average, 45% of total organic carbon (TOC) and 85% of light absorbing matter were removed by calcium carbonate precipitation. An additional 16% TOC and 7% of light absorbing matter were removed by magnesium hydroxide, leaving a non-removable fraction of 39% of TOC and 8% of light absorbing matter. The relationship between TOC or light absorbing matter removal and magnesium hydroxide precipitation was expressed as an adsorption isotherm similar to a Freundlich adsorption isotherm. Maximum adsorption capacity was 1.5-3.0 mg TOC per mg Mg. (Cassar-FRC)
W82-06053

ALGAL GROWTH IN PRIMARY SETTLED SEWAGE--THE EFFECTS OF FIVE KEY VARIABLES,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
S. Y. Ip, J. S. Bridger, C. T. Chin, W. R. B. Martin, and W. G. C. Raper.
Water Research, Vol 16, No 5, p 621-632, May, 1982. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Algal growth, *Wastewater lagoons, *Wastewater treatment, Photoperiodism, Temperature effects, Carbon dioxide, Nitrogen removal, Phosphorus removal, Biomass, Bicarbonates, Nitrates, Ammonium nitrate, Cyanophyta, Chlorophyta, Algae harvesting, Productivity.

The effects of photoperiod, temperature, carbon dioxide, bicarbonate, and nitrogen on algal growth in wastewater ponds were investigated in bench scale experiments at high and low levels for each factor. High and low levels were: photoperiod, 12 and 6 hours; temperature, 30 and 15 C; carbon dioxide, 1% and 0.03%; bicarbonate, 100 mg per liter NaHCO3 added and sewage as received; and nitrogen, 30 mg per liter ammonium nitrate added and sewage as received. Domestic sewage from a Melbourne suburb was used. Photoperiod at 3240 lx light intensity was the primary limiting factor on algal growth. At a retention time of 7 days, a total effective photoperiod of > 6 hours per day was required to produce algae at concentrations above 500 mg per liter. Increasing dissolved carbon dioxide levels encouraged production of green algae, which were unicellular and hard to harvest. The lower level of CO2 favored the more gelatinous and filamentous blue-green algae. Low temperature (15 C) promoted algal growth by increasing CO2 solubility. Algal production was increased by addition of carbonate and was decreased by addition of excess ammonium nitrate. In this experiment nitrogen removal was 3 mg per 100 mg biomass produced; phosphorus removal was 0.5 mg per 100 mg biomass produced. (Cassar-FRC)
W82-06055

ENERGY CONSERVATION IN MUNICIPAL WASTEWATER PLANTS,
New York State Energy Office, Albany.
E. R. Bogardus.
Clearwaters, Vol 12, No 1, p 10, 11-14, March, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Municipal wastewater, *Energy conservation, Wastewater treatment, Cost analysis, Economic aspects, Anaerobic digestion, Maintenance, Training.

The role of the New York State Energy Office in the development and coordination of an overall state energy program is discussed. Results of a recently completed Energy Office study on eleven New York State wastewater plants wasting digester gas are presented. Plans for the 1982 Energy Office wastewater program are detailed. The State Energy Master Plan provides the framework for energy decisions throughout the State. Conservation is the cornerstone for the energy plans. New York has been disproportionately affected by events related to escalating petroleum prices and supply shortages. While New York is the sixth largest energy user among all the states, only 9.5% of the total demand is satisfied from resources produced within the state. The Energy Office conservation program focuses on existing wastewater treatment facilities. Process reliability has been linked in the past to the high use and ready availability of energy for pumping, compressing air, and handling sludge. The key to the successful operation of an anaerobic digester is to maintain proper environmental conditions so that a balance exists between the acid-forming and the methane-forming bacteria. Vital to energy conservation and production is increased wastewater operator training, as these individuals are the key to a program's success or failure. The Energy Office expects the shift from site-specific activity to broad-based information dissemination to help meet this need. (Baker-FRC)
W82-06070

NEW DIRECTIONS IN WATER POLLUTION CONTROL,
Environmental Protection Agency, New York. Region II.
For primary bibliographic entry see Field 5G.
W82-06071

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WATER TREATMENT BY AQUATIC ECOSYSTEM: NUTRIENT REMOVAL RESERVOIRS AND FLOODED FIELDS,
Florida Univ., Sanford. Agricultural Research and Education Center.
K. R. Reddy, P. D. Sacco, D. A. Graetz, K. L. Campbell, and L. R. Sinclair.
Environmental Management, Vol 6, No 3, p 261-271, 1982. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Nutrient removal, *Water treatment, Nitrogen, Phosphorus, Phosphates, Aquatic plants, Storage ponds, Ponds, Reservoirs, Wastewater treatment.

An evaluation was made of the potential use of reservoirs and flooded fields stocked with aquatic plants for reducing the nutrient levels of organic soil drainage water. Treatment systems included: a large single reservoir stocked with waterhyacinth, elodea, and cattails (R1); three small reservoirs in series with waterhyacinth, elodea, and cattails grown in independent reservoirs R2, R3, and R4, respectively; a control reservoir (R5) with no cultivated plants; a large single flooded field planted to cattails; three small flooded fields in a series planted to cattails; and a flooded field with no cultivated plants. Drainage water was pumped daily into these systems for 27 months. Water samples were collected at the inlet and outlet of each treatment system and analyzed for nitrogen and phosphorus forms. The series of reservoirs stocked with aquatic plants functioned effectively in the removal of N and P from agricultural drainage water, compared to a single large reservoir. Allowing the water to flow through the reservoir stocked with waterhyacinth plants with a residence time of 3.6 days was adequate to remove about 50% of the incoming inorganic nitrogen. Allowing water to flow through a series of two small reservoirs with a residence time of 7.3 days was needed to remove about 60% of the incoming orthophosphates. Flooded fields were effective in the removal of inorganic nitrogen, but showed poor efficiency in the removal of ortho-phosphates. (Baker-FRC)
W82-06078

COMPARISON OF THE EXTRACTABILITIES OF ZN, CU, NI AND CR FROM SEWAGE SLUDGES PREPARED BY TREATING RAW SEWAGE WITH THE METAL SALTS BEFORE OR AFTER ANAEROBIC DIGESTION,
Rothamsted Experimental Station, Harpenden (England).
C. Bloomfield, and S. P. McGrath.
Environmental Pollution, Vol 3, No 3, p 193-198, 1982. 1 Fig, 2 Tab, 14 Ref.

Descriptors: Metals, *Anaerobic digestion, Sludge, *Nickel, *Copper, *Chromium, *Zinc, Wastewater treatment, Extraction techniques.

The extractabilities of zinc, copper, nickel and chromium from sludge prepared by anaerobic digestion of relatively uncontaminated raw sewage was compared in the presence of salts of the metals with those from sludge prepared from the same batch of raw sewage and equilibrated with the metals subsequent to anaerobic digestion. The digestion and sorption metal treatments enriched the sludge to roughly the same extents. Such differences as there were probably resulted from the heterogeneity of the original sewage and the consequent unequal amounts of dry matter in the various batches. Neither the digestion nor the sorption treatments had any sifnificant effect on the total contents of the metals native to the original sewage, although it is possible that the nickel sorption treatment may have displaced some zinc. All three extractants removed metals sorbed on predigested sludge more readily than those incorporated during the digestion process. Barely significant amounts of zinc, copper or chromium, either native or applied, were extracted by neutral ammonium acetate from sludge formed in the presence of the metals, but nearly 26% of the added nickel was removed by this reagent. Only slightly more nickel was extracted from the sorption product, but ammonium acetate removed between 7 and 8 times as much sorbed as digested zinc and copper. The amounts of chromium extracted by ammonium acetate from the two preparations did not differ significantly. Similarly the availabilities of the metals as determined by extraction with acetic acid or EDTA were considerably less in sludge formed by digestion in the presence of the metals than in sludge obtained by treatment with the salts subsequent to the digestion process. (Baker-FRC)
W82-06079

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,
Ben-Gurion Univ. of the Negev, Geersheba (Israel).
For primary bibliographic entry see Field 5A.
W82-06117

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,
Ben-Gurion Univ. of the Negev, Beersheba (Israel).
For primary bibliographic entry see Field 3A.
W82-06118

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
Ali M. El-Nashar.
Desalination, Vol 33, No 1, p 21-48, April, 1980. 18 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Membranes, Energy conservation, Water conservation, Membrane processes, *Recycling, Water reuse.

Textile dyeing operations consume large amounts of process water and thermal energy. The wastewater resulting from these operations contains various types of contaminants of organic and inorganic origin. This wastewater has an above average temperature. The possibility of renovating and recycling a major portion of this wastewater would reduce the water and energy consumption by these dyeing operations. This paper presents pilot plant test results using Zr(IV)-PAA dynamic RO membrane modules for treating dyeing wastewater. Using these results, a mathematical model was presented to evaluate the design parameters and economic feasibility of a 1000m3/day plant for treating and recyclig dyeing wastewater. The economic results show that a net profit could be obtained by recycling product water. (Balaban-Boston)
W82-06123

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, C. H. Dean, R. R. Jacobs, M. E. Knuckles, and R. E. Wagner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243650, Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report No 168 (UNC-WRRI-81-168), June 1981. 39 p, 1 Fig, 15 Tab, 25 Ref. OWRT A-090-NC(6), 14-34-0001-7070.

Descriptors: *Enteroviruses, *Wastewater treatment, *Soil types, *Soil absorption capacity, *Wastewater treatment, Path of pollutants, Viruses, Soil chemistry, Soil saturation, Clays, Organic soils, Sand, Sorption, Retention, Retention capacity, Adsorption, Adsorbents, Soil treatment systems.

Laboratory and pilot-scale studies were carried out on the interactions and survival of representatives of two different enteric virus groups (poliovirus type 1 and reovirus type 3) in 11 different soil materials in settled sewage. Three were marked differences in the abilities of the soil materials to remove/retain viruses from the sewage, but for each soil material the behavior of the two viruses was often similar. Virus absorption to soils was rapid, mostly occurring in 15 minutes. Clayey materials effectively absorbed both viruses from wastewater over a range of pH and total dissolved solids (TDS). Sands and organic soils were relatively poor sorbents, but, in some cases, their viral sorption ability increased at low pH and with the addition of TDS or divalent cations. In pilot-scale studies with 5-foot long columns (3-foot unsaturated upper zones; 2-foot, saturated bottom zones), extensive reductions of the two viruses occurred when septic tank effluent (30,000-60,000 viral plaque-forming units/ml) was applied at 1.3 inches/day over 8-week periods; no viruses were detected in extracts from the column soil materials that had relatively poor virus sorbent capabilities. It appears that extensive virus reduction can occur in such soils when there is sufficient depth of unsaturated flow; the effects of periodic rainfall, however, must be further investigated. (Zielinski-MAXIMA)
W82-06150

AUTOMATION AT NORWICH SEWAGE-TREATMENT WORK: FIVE YEARS' EXPERIENCE,
Anglian Water Authority (England).
P. Cotton.
Water Pollution Control, Vol 80, No 2, p 243-259, 1981. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Wastewater facilities, *Computers, Planning, Design criteria, Water Treatment facilities, *Norwich, Great Britain.

The Norwich sewage treatment works of the Anglian Water Authority is described. The works serves the City of Norwich and surrounding districts, and has a design DWF of 55 tcmd derived from a contributing population of 200,000 since undergoing extensions between 1973 and 1975. Preliminary treatment comprises rotary-cup screens, disintegrators and detritors. After separation of storm sewage at about 3 DWF, sewage is proportioned between two plants operating in parallel. One comprises primary sedimentation tanks , bioligical filters and humus tanks, and the other primary sedimentation tanks, diffused-air activated-sludge plant and secondary settlement tanks. Sludge treatment is also effected through two parallel plants, one comprising consolidation tanks, primary heated anaerobic digestion tanks, and open secondary digestion tanks, and the other, storage tanks and the pressure-filtration plant. Plant operations are monitored and controlled from the central control room, where the operator communicates with the computer system via the operator control panel and the logging printer. Cost analysis information is included. (Baker-FRC)
W82-06157

APPROPRIATE SELECTION OF WATER/WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,
Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, A. Law, and T. Chaudhry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254889, Price codes: A05 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Stillwater, Report, March 1982. 78 p, 2 Fig, 11 Tab, 15 Ref, 5 Append. OWRT A-100-OKLA(1), 14-34-0001-1138.

Descriptors: *Rural areas, *Computer models, *Water treatment, *Wastewater treatment, *Water quality control, Mathematical models, Model studies, Computer programs, Mathematical studies, Social participation, Public participation, Water use, Water supply development, Water pollution control, Water pollution prevention, Project planning, Planning, Alternative planning, Water quality, *Wastewater facilities.

Small communities often have to resort to usage of highly inappropriate and sophisticated systems that are difficult to operate and maintain with regard to their water supply and sanitation needs. A computer application model is presented that will aid engineers/planners in determining a community's needs and resources. Two versions of this model

were developed: one, for use on a low-cost microcomputer; the other, for use with a hand-held calculator. Both of these versions consider the socio-technological level of the community, as well as indigenous information covering water quality and demographic data. Four communities in the rural and urban fringe in Oklahoma were selected for testing the validity of this model. The model identifies water and waste treatment alternatives which are compatible with local available resources and manpower capabilities; application of appropriate technology substantially enhances the ability of the community to satisfy its water and wastewater treatment objectives. Community information was obtained from the use of two survey questionaires to assist identification of appropriate technology for water/wastewater treatment. (Zielinski-MAXIMA)
W82-06162

APPARATUS FOR HIGH-EFFICIENT MICROBIOLOGICAL OXIDATION TREATMENT,
Hitachi Ltd. (Japan). (Assignee).
N. Shimizu, Y. Odawara, T. Yamaguchi, S. Saitou, and A. Nakaoka.
U.S. Patent No 4,203,841, 8 p, 5 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 986-987, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Organic wastes, Aeration, Activated sludge, Oxygen, Equipment, Bacteria, Oxygen demand, Oxidation, *Biological oxidation, Oxygen transfer rate.

Waste water containing organic materials is introduced into an aeration tank, and is subjected to aeration treatment in the presence of activated sludge, while supplying oxygen to the aeration tank. The tank is provided with an air diffusion pipe at the bottom of the tank, an air dispersion device above the air diffusion pipe and a number of inside cylinders above the air dispersion device. An overall circulating stream and partial circulating streams are generated in the aeration tank. (Sinha-OEIS)
W82-06166

FACTORS AFFECTING FLOG FORMATION AND BULKING IN THE ACTIVATED SLUDGE PROCESS FOR TREATMENT OF TEXTILE WASTE WATERS,
Auburn Univ., AL. Dept. of Botany, Plant Pathology, and Microbiology.
W. T. Blevins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254954, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 23 p, 1 Fig, 4 Tab, 3 Ref. OWRT A-073-ALA(1), 14-34-0001.

Descriptors: *Textile mill wastes, *Microbiological studies, *Activated sludge, *Sludge volume index, Industrial wastes, Solid wastes, Microorganisms, Microscopic analysis, Microscopy, Bacterial analysis, Bacteria, Sewage bacteria, Sodium, Sludge, Sludge disposal, *Wastewater treatment.

A textile and municipal wastes activated-sludge facility was studied microbiologically during normal sludge settling/bulking periods, and factors influencing the degree of microbial flocculation and effluent quality were examined. Total viable numbers of bacteria were determined, and isolates were taxonomically characterized. A filamementous bacterium (resembling Eikelboom's Type 0961, known to predominate some activated-sludge reactors with low food/microorganism ratios) was the most prevalent in bulking sludge. Prevalent genera indicated relative stability in the community population structure at this facility. Predominant bacteria were species of Acinetobacter, Alcaligenes, Pseudomones, and Flavobacterium. All bacteria isolates flocculated well in synthetiuc media and/or sterilized wastewaters. Unusually high COD/BOD ratios suggested an effluent of chemically low quality, and the dominance of small flagellates (Bodo sp. and Notoselenus sp.) implicated a resultant low quality effluent. Temperatures of 20-25 degrees and pH 8.5 support optimal settleability and lowest sludge volume index values. High sodium ion levels from the textile mill dramatically affected settleability, which improves with increasing divalent cation levels. (Zielinski-MAXIMA)
W82-06171

ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,
Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
D. D. Ellis, C. M. Jone, R. A. Larson, and D. J. Schaeffer.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 373-382, 1982. 4 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Mutagens, *Organic compounds, *Effluents, Pollutant identification, Carcinogens, *Secondary wastewater, Priority pollutants, Hydrocarbons, Aromatic compounds, Phenols, Fatty acids, Chlorinated compounds, Nitrogen compounds, Pesticides, Phthalates.

Samples of mutagenically active effluents from Illinois industrial and municipal wastewater treatment plants were analyzed by capillary gas chromatography/mass spectroscopy. A total of 243 organic compounds were tentatively identified. Twenty of these were priority pollutants, and 33 were not previously detected in water samples. Among the compounds found wre hydrocarbons (straight chain, aromtic, and polyaromatic), phenols, alcohols, terpenes, ketones, aldehydes, organic acids and esters (including fatty acids and fats), plasticizers, ethers, halogenated compounds, nitrogen compouns (pyridines, anilines, etc.) and pesticides. The only known carcinogenic or mutagenic materials were N-nitrosodimethylamine and o-toluidine. However, most of the compounds detected in the effluents have not been tested for genetic activity. It is also possible that active mutagens may be present but undetected by the method of analysis used. (Cassar-FRC)
W82-06178

WATER POLLUTION CONTROL PLANT UPGRADED TO MEET EPA REGS.
Civil Engineering (New York), Vol 52, No 6, p 56-57, June, 1982.

Descriptors: *Water treatment facilities, *Water pollution control, Regulations, design criteria, Philadelphia, Energy conservation, Delaware River, Water quality, River basins, Computers, Automation, Wastewater treatment, Industrial waste, Municipal waste.

A $300 million addition was made to the Southwest Water Pollution Control Plant in Philadelphia which nearly doubles the plant capacity to 210 mgd. Plant operators were consulted extensively during the design, and considerable time was spent converting operating experiences into engineering data and plans. One outcome was a computerized control system. To expedite the treatment process, the plant uses pure oxygen rather than air. The plant produces its own oxygen by using a cryogenic fractional distillation oxygen unit. Since construction took place during normal plant operation, special techniques were used to keep the process going. The waste gas is collected at low pressure from the sludge digestion tanks and is compressed by two 125-horsepower rotary gas compressors for distribution throughout the plant. Sludge gas is used for sludge heating, space heating, scum incineration and grit incineration. (Baker-FRC)
W82-06187

THE INFLUENCE OF TRANSIENT TEMPERATURE CHANGES ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
L. A. Obeng, R. Perry, and J. N. Lester.
Environmental Pollution, Series A, Vol 28, No 2, p 149-161, 1982. 8 Fig, 1 Tab, 35 Ref.

Descriptors: *Activated sludge process, *Temperature effects, Sludge, Metals, Biodegradation, Cadmium, Lead, Zinc, Copper, Heavy metals, *Wastewater treatment, *Nitrilotriacetic acid, Detergents.

Experiments were performed to determine the effects of transient reductions in temperature to values of about 12 degrees C and values of less than 10 degrees C on the biodegradation of NTA (nitrilotriacetic acid) and any consequent effects on effluent metal concentrations. To determine the effect of transient reductions in temperature, four experiments were undertaken. In each experiment two activated sludge simulations were subjected to an identical temperature shock. The two were in a comparable condition prior to treatment, except that the influent to one contained 10 mg/liter of NTA, which was being consistently biodegraded. Two temperature shocks were examined, first from 17.5 to 12.5 degrees C over 4 hr. remaining at that temperature for 8 hr, and second, from 17.5 to 9.5 degrees C in 8 hr, remaining there for 6 hr before returning to 17.5 during the following 10 hr. The results demonstrate that there were no adverse effects on the biodegradation of NTA and no effect on effluent metal concentrations when the temperature was decreased from 17.5 to 12.5 degrees C. However, a drop from 17.5 to about 9.5 resulted in incomplete biodegradation of NTA and an associated increase in effluent concentrations of cadmium, copper, lead, and zinc. These effects were reversed as the temperature was allowed to return to 17.5 degrees C. (Baker-FRC)
W82-06193

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,
North Dakota State Univ., Fargo. Dept. of Bacteriology.
K. R. Mitchell, and B. R. Funke.
Environmental Pollution, Series A, Vol 28, No 2, p 81-88, 1982. 4 Tab, 20 Ref. OWRT A-057-NDAK.

Descriptors: *Bacteria, *Food-processing industry, Flumes, *Industrial wastes, *Food-processing wastes, Wastewater, Coliforms, Salmonella, Fecal bacteria, Beets, Spray irrigation, *Enteric bacteria.

Refinery processing waters at the Red River Valley and Minnesota sugarbeet processing plants were examined for enteric bacteria. At the Hillsboro, North Dakota sugarbeet refining plant the processing waters are circulated in a closed system. Water used in the flume and washer is obtained from a freshwater reservoir and, after use, is pumped through a clarifier to remove settleable solids and returned for reuse. During processing additional water accumulates from the beet. Lime is used during sugar purification and enters the wastewater stream through the clarifier. Underflow containing settleable solids from the clarifier is pumped into the lime mud pond. Water from this pond can then be pumped to a sequence of small lagoons, then through an activated sludge treatment system into the freshwater reservoir for reuse. When the reservoir is full, water is transferred into an irrigation lagoon for eventual disposal by spray irrigation. All of the tested processing waters were positive for Salmonella at least once. The soil adhering to beets was tested for Salmonella and fecal coliforms, and substantial numbers were found in some samples. While determining the source of the problem was not part of the study, all of the farmers from whose land Salmonella-containing sugarbeet originated were contacted and denied use of animal manures on their land. Samples of alfalfa grown on the irrigated plot showed no Salmonellae or fecal coliforms. Concern for aerosol transmission of Salmonella in the spray irrigation process is voiced. At present the presence of Salmonella and fecal coliforms in sugar beet refining processing waters does not appear to represent a public health hazard in relation to their disposal by spray irrigation. However, the Salmonella populations found in the early part of the processing season in flume waters, in excess of one million per 100 ml, could be a hazard for workers coming in contact with flume waters. (Baker-FRC)
W82-06195

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ELIMINATION OF ODOR FROM ANAEROBIC LAGOONS,
Greeley Dept. of Public Works and Utilities, CO.
C. W. Hargett, Jr., and M. H. Rybus.
Public Works, Vol 113, No 5, p 82-83, May, 1982. 1 Fig.

Descriptors: *Odor control, *Lagoons, *Meat processing industry, *Anaerobic lagoons, Wastewater lagoons, *Wastewater treatment, Greeley, *Colorado, Biological oxygen demand, Aeration, Scum.

An anaerobic lagoon system treating meat packing plant wastes in Greely, Colorado, had persistent odor problems since its startup in 1973. Methods of odor control which were ineffective included channeling flow to only one lagoon of the four, aeration on the surface, pouring gasoline on the surface and igniting it, adding grease to improve the quality of the scum blanket, and deodorant spraying. The odor problem was eventually overcome by using heavy organic loadings (12 pounds BOD per 1000 cu ft of water) and loading one lagoon at a time to form a thick and strong scum blanket to prevent odors from escaping. (Cassar-FRC)
W82-06221

TREATMENT OF PULP AND PAPER INDUSTRY WASTEWATERS IN AN ANAEROBIC FLUIDIZED BED REACTOR,
Enso-Guzeit Osakeyhtio, Imatra (Finland).
R. Hakulinen, and M. Salkinoja-Salonen.
Process Biochemistry, Vol 17, No 2, p 18-22, March/April, 1982. 7 Fig, 5 Tab, 30 Ref.

Descriptors: *Pulp and paper industry, *Anaerobic digestion, *Fluidized beds, *Wastewater treatment, Industrial wastewater, Aerobic digestion, Biological treatment, Mutagens, Toxicity, Daphnia, Trickling filters, Bleaching wastes, Pulp wastes, Chlorophenols.

Three pulp and paper mill wastewaters (spent bleach liquor from kraft pulping, thermomechanical pulping effluent, and debarking wastewater) were treated by fluidized bed anaerobic digestion followed by secondary aerobic treatment. In the pilot plant BOD removals were: bleach liquor, 61-73% at hydraulic loadings of 1.5-3 cu m per cu m of total reactor volume; thermomechanical pulping effluent without dithionite, 94% for a loading of 1 cu m per cu m; 90% for thermomechanical pulping effluent with dithionite for a loading of 1 cu m per cu m; and 82% for debarking wastewater at a loading of 0.66 cu m per cu m. 93-95% of chlorophenolic compounds from bleach liquor at the 1.5 cu m per cu m loading were mineralized to CO2 and chloride ions. All mutagenicity (monitored by the Ames test) and toxicity to Daphnia were removed from the wastewaters. (Cassar-FRC)
W82-06226

HOW APPLETON REDUCED PHOSPHORUS,
Wastewater Treatment Plant, Appleton, WI.
P. Wachs, and E. L. Laurent.
Water/Engineering and Management, Vol 129, No 5, p 32, 34, May, 1982. 2 Tab.

Descriptors: *Phosphorus removal, *Wastewater treatment, Water treatment facilities, Appleton, *Wisconsin, Alum, Biochemical oxygen demand, Oxygen demand, Regulations, Chemical coagulation, Seasonal variations, Flow, Industrial waste.

Chemical processing facilities were installed in the late 1930s in the city of Appleton, Wisconsin, to treat domestic and industrial wastewater. The plant performed seasonal chemical treatment during periods of low river flow. Industries in the area included paper mills, canneries, dairies and small industries. The plant could not meet the modern state phosphorus concentration requirements. In the early days rduction of phosphorus was accomplished by adding metal salts. Recently, the return of the sludge oxidation decant liquor to the head of the aeration tanks interfered with the ability of the added metal salt to react with phosphorus. Liquid alum was applied in 1980 at the end of the aeration process and successfully reduced phosphorus to the required levels. The alum was compatible as a coagulant with the sludge oxidation decant liquor, and this solids reduction method is currently in use. Solids which are recovered are then concentrated and spread over nearby farm land as fertilizers. Activated sludge is moved from secondary clarifiers to four dissolved air flotation units for thickening. Primary clarifier sludge is added to the thickened sludge, and the mixture passes to a wet oxidation stage. Oxidized sludge is transferred to decant taxes. The plant now meets the state phosphorus limit of 1 mg/liter in the effluent. Increased removal efficiencies of BOD and suspended solids have also been achieved. In the returned activated sludge, total suspended solids vary from 9,000 to 11,000 mg/liter. Mixed liquor TSS range from 2,500 to 4,000 mg/liter. Sludge volume index remains between 60 and 70, which indicates very good settling. (Baker-FRC)
W82-06249

POLYMER PLAYS PLANT IMPROVEMENT ROLE,
W. VanCott, and J. F. Moore.
Water/Engineering and Management, Vol 129, No 5, p 48, 50, May, 1982.

Descriptors: *Wastewater treatment, *Phosphate removal, Economic aspects, Activated sludge process, Polymers, *Ohio, Management, Toledo.

Changes have been instituted at the Bay View Water Reclamation Plant in toledo to improve performance and stay within the limits imposed by the Ohio Environmental Protection Agency. These changes include a reduction in operating personnel, control of maintenance overtime, adoption of a preventive maintenance program, institution of chemical and energy reduction programs, implementation of operator training and safety seminars, and negotiation of a new sludge hauling and land spreading contract. A significant change in phosphate removal with resultant savings in chemicals and direct labor was also brought about through the use of a new gel polymer installation at the primary clarification stage. A steel mill waste pickle liquor was used in place of ferric chloride in the preaeration tanks, with resultant chemical cost savings of over 90%. The anionic polymer was needed to settle the iron phosphate precipitate that formed. The polymer is injected into the inlet channels of the primary clarifiers, where it contacts the phosphate floc in the wastewater stream and begins to promote settling. A gel grinding unit was installed as part of the completely automatic mixing system. This significantly reduced the time spent in the chemical building to maintain equipment and keep the area clean. Phosphorus concentration in the treated effluent averaged 0.6 mg/liter during 1980, and the plant kept within standards during 1981. (Baker-FRC)
W82-06250

A LEGACY FROM CONSTRUCTION GRANTS,
Donohue and Associates, Inc., Sheboygan, WI.
J. S. Kipp.
Water/Engineering and Management, Vol 129, No 5, p 38-40, May, 1982.

Descriptors: *Sewer systems, *Maintenance, Federal jurisdiction, Environmental Protection Agency, Grants, Construction.

Communities must begin to face wastewater related problems in innovative ways. Participation in scores of wastewater collection and treatment projects has provided consulting firms with the opportunity to observe a broad range of system conditions and configurations. During sewer system studies the full spectrum of system maintenance situations has been encountered, from emergency-only responses to planned and full scale sewer maintenance programs. The new approaches, along with recently developed repair methods and products, represent long term benefits of the declining Construction Grants Programs. A comprehensive program for collection system maintenance includes a series of support functions, inspection techniques and repair methods. Planned and carried out on a regular basis, such a program identifies, documents and repairs sewer system defects to mitigate the effects of existing deficiencies and prevent the development of new problems. A typical sewer maintenance program can consist of three distinct phases: smoke testing, surface survey of manholes and manhole frame testing; dye water flooding and complete man-hole inspection; and sewer cleaning, internal television inspection and root control. System size, sewer age, existing problems, present maintenance staff and future areas for expansion all need to be addressed when establishing a program. (Baker-FRC)
W82-06251

SEWER MAINTENANCE AND REHAB OPTIONS,
Burns and McDonnell, Kansas City, MO.
P. L. Andrews, and S. A. Yonker.
Water/Engineering and Management, Vol 129, No 5, p 38-40, 42, 46, May, 1982. 2 Tab.

Descriptors: *Sewer systems, *Maintenance, Linings, Pipes, Inspection, *Rehabilitation.

The Environmental Protection Agency has a requirement in its construction Grants proram that excessive amounts of infiltration/inflow entering sewer systems be eliminated. Concern for cost, safety and reliability has spawned new sewer cleaning and rehabilitation techniques, materials and methods. Sewer deterioration can be caused by a number of different circumstances, including corrosion or structural failure. For many years sewer cleaning was the only method other than replacement used to rehabilitate sewers. The variety of methods available for sewer cleaning includes rodding machines, bucket machines, and hydraulic cleaning devices. The effectiveness of sewer cleaning equipment will vary depending upon local conditions. Accessibility to the sewer is also a determining factor. Inspection of the sewer system is needed if other sewer rehabilitation steps are to be taken. Television inspection is the most prominent of the techniques for inspection which are available. The inspection is made to identify the type and location of defects. Rehabilitation methods once the problem is located include various methods and materials, most involving replacement or restoration of the interior surface of the pipe and the integrity of the pipe joints. Procedures external to the pipe are potentially effective as well. External methods involve methods involve the use of various grouts. Replacement or restoration of the interior pipe wall may call for slip lining, which involves inserting a polyethylene pipe with an outside diameter slightly smaller than the inside diameter of the original pipe being repaired. A recent adaptation of slip lining involves use of a resin-saturated fabric tube. (Baker-FRC)
W82-06253

THE QUANTIFICATION OF THE EMISSIONS AND DISPERSION OF ODOURS FROM SEWAGE-TREATMENT WORKS,
Warren Spring Lab., Stevenage (England). Pollution Div.
A. W. C. Keddie.
Water Pollution Control, Vol 81, No 2, p 266-279, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Odor control, Odors, Public opinion, Air pollution. Air circulation, Atmosphere.

In this paper the relative importance of sewage treatment/disposal as a source of odor complaints is briefly reviewed and then some of the problems of identifying and quantifying odorous emissions are described. The role and limitations of atmospheric dispersion in diluting odors to acceptable levels are outlined. According to a recent survey carried out in the United Kingdom, sewerage and sewage treatment still accounts for a significant number of identified sources of odors and for numerous complaints from the general public. There are many potential odor sources within a treatment works, including incoming sewage, primary sedimentation, biological treatment and holding tanks, sludge digestion and sludge disposal. While it is hard to quantify the volume flow of odorous air

and consequently the odor emission rate, these difficulties can be partly overcome by making use of the knowledge of atmospheric dispersion. Chemical analysis of odorous compounds emitted from sewage works, using methods based on gas chromatography, has met with only limited success in respect to identifying source and quantification. Using relatively simple dispersion formulae, corrected for the fact that the human nose responds to stimuli of only a few seconds duration, and given an estimate of the total emission from a works it is possible to calculate the potential for complaints from the public for a works in question. (Baker-FRC)
W82-06255

EXPERIMENTAL DATA ABOUT WASTEWATER TERTIARY TREATMENT WITH OZONE,
Trailigaz Co. (France). Research and Application Dept.
J. P. Legeron.
Water Pollution Control, Vol 81, No 2, p 166-176, 1982. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Ozone, *Tertiary wastewater treatment, Advanced wastewater treatment, Sewage, Coliforms, Bacteria, Disinfection.

Ozone treatment was tested in a pilot plant on semi-industrial effluents, which also included waste from hospitals and clinics. The wastewater in question had previously been given treatment comprising screening, grit and oil removal, primary sedimentation, biilogical treatment by activated sludge and secondary settlement. It was then discharged into a river reaching the sea less than 10 km downstream. The risk of health and hygiene problems had to be reduced by disinfection because oyster farms and bathing areas were located near the mouth of the river. The pilot plant includes an ozone generator and a gas-liquid contact system. With this equipment 36 g of ozone can be produced per hour at a 2% concentration by weight. With a distribution pattern of 40%, 40%, 15% and 15% and a dosage rate of 10 mg ozone per liter of effluent, a total coliform content of no more than 1000/100 ml can be obtained in most cases. A retention period of 11 minutes 20 seconds proved more effective than 20 minutes. While a relation was found between the effective dosage rate and the ozone content in the carrier gas, the reduction in coliforms also depended on water quality. Ozone can also be injected so that only traces of dissolved ozone will be present in the water at the outlet from the first column, with a concentration of 0.3 mg/liter in the effluents from the other three columns, without impairing the degree of disinfection. Such a factor can be used for setting up a process control system linking ozone production to the quality variations of the sewage effluent. (Baker-FRC)
W82-06257

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,
North-West Water Authority (England).
A. P. Michaelson, J. L. Thompson, A. M. Bruce, and R. C. Frost.
Water Pollution Control, Vol 81, No 2, p 220-240, 1982. 14 Fig, 2 Tab, 19 Ref.

Descriptors: *Sludge, *Pumping, *Reviews, Economic aspects, Conveyance, Rheology, *Wastewater treatment, Pipelines, Hydraulics, Design criteria, Viscosity, Mathematical studies, Model studies, Sludge thickening, Pumps.

This paper provides a broad account of the results obtained from two studies, one related particularly to the use of pipelines for transporting sludges over very long distances, and the other on sludge pumping. The rheological behavior of sewage sludges is generally described as 'non-Newtonian' and is more complex and variable than that of Newtonian fluids. In designing a system for pumping sludges it is essential to obtain an accurate estimate of the friction losses likely to occur over the range of designflow rates and likely pipe diameters. Rule of thumb assumptions about the flow behavior of sludges may lead to substantial errors in prediction of head losses under some flow conditions. Even pipelone systems of relatively short length, such as within a system, can present design uncertainties, especially where thickened sludges are to be pumped. For most types of sludge, friction head losses in pieplines when flow is in the turbulent range are normally no greater than 1.5 times those for water flowing at the same velocity. To predict head losses it is necessary to determine the actual flow characteristics of the particular sludge. The resistance to flow of different sludges is variable and influenced by solids content. The design philosophy should be based on an operating velocity which is high enough to ensure transitional flow for the thickest sludge. (Baker-FRC)
W82-06258

THE USE OF OXYGEN IN SEWAGE TREATMENT,
Wessex Water Authority (England).
R. G. Toms, and M. G. Booth.
Water Pollution Control, Vol 81, No 2, p 151-165, 1982. 4 fig, 6 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Oxygenation, *Reviews, Aeration, Activated sludge process, Sludge, *Oxygen, Wastewater treatment facilities, Unox process, Nitrification.

A broad review is offered of the use of oxygen in the treatment of sewage. A high rate oxygen activated sludge treatment process was first developed in the early 1960s, using oxygen in place of air to accomplish biochemical oxidation. Such treatment was begun in 1976 by the Wessex Water Authority due to the small land requirement for the process to be effective. This was the first Unox plant to be built in the United Kingdom, and its efficiency has been studies in detail. Oxygen treatment was also used to uprate an activated plant at Holdenhurst. An examination of the plant showed that the aerators in the activated sludge process were not able to maintain a satisfactory dissolved oxygen content of 4% saturation half-way along the aeration lanes with a minimum of 10% saturation at the outlet. The low DO content caused the plant to produce an effluence below acceptable standards. An additional 5.5 tonnes/day of oxygenation capacity were needed for full nitrification. Additional oxygenation capacity, once installed, resulted in a good quality effluent being produced, with about 91% of the BOD load and 13% of the ammonia load being removed. Oxygen was also used to treat sewage in a rising main. The Saltford sewage treatment works became overloaded and in the early 1970s did not produce an acceptable effluent. Peformance at the plant was seriously affected by a poor-settling activated sludge, associated with the presence of filamentous bacteria in the influent, whose presence was attributed to the fact that the crude sewage was septic. Oxygen was injected into the bottom of the rising main in the pumping station, eliminating the filamentous bacteria, but not improving settleability of the activated sludge. (Baker-FRC)
W82-06262

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,
Turbitrol Co., Atlanta, GA.
E. F. Morey.
In: Water/Engineering and Management, Reference Handbook--1982, p 6-7, May, 1982.

Descriptors: *Maintenance, *Measuring instruments, Operating costs, Planning, Electrical equipment, Hydraulic equipment, Laboratory equipment, Mechanical equipment.

Basic ideas and principles of instrument maintenance in water and wastewater treatment plants are considered. Instrument maintenance may be divided into two main areas - the management aspect and the technical phase. Management involves decisions about how to establish the manpower that will be needed to peform the work and procedures for establishing the acutal maintenance programs. The technical areas involve the aspects of maintaining, adjusting, and repairing instrument maintenance shop available where bench service work can be performed. Good documentation is essential for proper operation of an instrument maintenance department. Some type of record system is needed to permit maintaining a chronological history of the maintenance and repair work done on each instrument device. For pneumatic and electronic instruments it is essential that the system be protected from problems associated with a bad air supply and a 'noisy' power supply. Electronic instrumentation should be provided with filters for the supply to the devices. Well-designed instrumentation and control systems have the potential of providing significant increases in plant operating efficiency. In order for proper maintenance to be done the operating staff will have to have that level of confidence that will result in a better job performed with higher efficiency. (Baker-FRC)
W82-06263

HOW TO SET UP A PREVENTIVE MAINTENANCE PROGRAM,
Operation Management Services, Wilton, CT.
B. W. Dahl.
In: Water/Engineeing and Management, Reference Handbook-1982, p 8-12, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Maintenance, *Planning, *Wastewater facilities, Electric equipment, Hydraulic equipment, Mechanical equipment, Laboratory equipment, Measuring instruments.

A preventive maintenance program in a wastewater treatment plant calls for secheduled cleaning, lubrication and minor adjustment of parts that do not require major overhaul or repair. The basis of such planned maintenance is scheduled inspection of all facilities, including inspection of all electrical switch gear and instruments as well as the mechanical equipment. This leads to discoveries of equipment that could cause breakdowns or harmful deterioration to occur. The first step in developing such a system is to determine the needed information. The second step is to make a preliminary assessment of the size and scope of the plant and the resultant preventive maintenance system so that one can intelligently select the hardware appraoch to be used. General components of the system must be defined, including an equipment identification system, a record of facts on each piece of equipment, a schedule for documentation of service performance, and a format for monitoring inventory of spare parts. Aside from the basic hardware all systems have the same pattern of data flow, consisting of the equipment lists along with all the specific data and schedules on each piece of equipment. This data forms the data base for system operation. The development of a preventive maintenance system calls for the initial survey of the size of the system needed and selection appropriate hardware, the assembly of all specific information on the equipment, and the fine tuning of the system. (Baker-FRC)
W82-06264

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
M. P. Pandey, and M. Chaudhuri.
Water Research, Vol 16, No 7, p 1113-1118, July, 1982. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Mercury, *Water treatment, Sorption, Adsorption, Coal, Oxidation, Activated carbon, Carbon, *Wastewater treatment.

Results are presented from a study conducted to screen a number of Indian bituminous coal samples for mercury sorption in water and improve the sorption capacity of the most promising one through chemical pretreatment. Continuous column studies were also conducted using mercury levels that are commonly encountered in natural water supplies or industrial wastewaters. The kinetics of mercury sorption onto activated carbon and coal samples was investigated. The two activated carbon samples were used as references to compare the performance of the coal samples. For all the sorbents the time required to attain equilibri-

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um sorption was about 12 hr. Filtrasorb 400 and Laxmi Carbon were comparable in terms of their initial rates of sorption as well as equilibrium mercury sorption capacities. Inital rates of sorption for Margherita and Makum coals were slightly lower compared to those for Giridih and singareni coals. Mercury sorption onto Giridih coal was temperature dependent and decreased with rising pH as well as chloride and calcium concentrations. Sorption follows the Freundlich equation and involves a rapid interaction between mercury and the active sites on the external surface of coal, followed by intraparticle diffusion of mercury for further rection. Chemical pretreatment of coal such as with nitirc acid oxidation, sulfonation and sulfurization further improved the sorpiton capacity. Column studies indicated the feasibility of using coal for removing mercury from water supplies or industrial wastewater. (Baker-FRC)
W82-06265

OPERATION OF HIGH-RATE OXIDATION PONDS: THEORY AND EXPERIMENTS,
Technion-Israel Inst. of Tech., Haifa (Israel).
Y. Azov, and G. Shelef.
Water Research, Vol 16, No 7, p 1153-1160, July, 1982. 6 Fig, 4 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Oxidation ponds, Oxidation lagoons, Lagoons, Temperature effects, Seasonal variation, Algal growth, Eutrophication, Solar radiation.

This study was aimed at achieving maximum algal biomass production and wastewater reclamation from a high oxidation pond through designing an operational strategy that would require minimal pond area for year round aerobic operation of the pond. It was assumed that increasing the algal portion of the total biomass produced in the pond would result in increased nutritional value of the biomass, subsequently harvested for use as protein rich animal feed. Theoretical considerations and year round outdoor pilot plant experiments were studied to compare the different basic approaches of large scale high-rate oxidation ponds (HROP) operation aimed at optimizing the performance of the system. Major factors affecting pond performance were solar radiation and water temperature: the former mainly determines maximal algal productivity, and the latter determines optimal retention time operation. Pond area and depth are the only true independent variables which may be manipulated to produce optimal retention time in year round operation. In the tropical regions, a constant retention time is most adequate for optimal operation, as water temperature is fairly constant year round and a constant area and depth strategy can be adopted. In moderate climates seasonally variable retention time is preferred, and it was found to be most economically achieved by varying pond depth at constant area. Another plausible strategy with possible economic advantages is a combination of dual function ponds, operating solely for wastewater treatment during winter, while some are converted into fish-rearing ponds during summper. (Baker-FRC)
W82-06266

A REVIEW OF THE MECHANISM OF POWDERED ACTIVATED CARBON ENHANCEMENT OF ACTIVATED SLUDGE TREATMENT,
C-E Natco, Tulsa, OK.
K. L. Sublette, E. H. Snider, and N. D. Sylvester.
Water Research, Vol 16, No 7, p 1075-1082, July, 1982. 1 Fig, 1 Tab, 47 Ref.

Descriptors: *Activated sludge process, *Reviews, *Wastewater treatment, Carbon, Sludge, *Activated carbon, Chemical reactions, Synergistic effects.

This paper reviews the available literature concerning powdered activated carbon enhancement of activated sludge treatment. Much investigative work has been devoted in the past 10 years to understanding the interaction of carbon adsorption and biological activity. Simple addition of effects seems unlikely, and an apparent synergism has been suggested. The source of this synergistic effect has been attributed to stimulation of biological activity through removal of inhibitory substances or concentration of nutrients and to bioregeneration of the adsorptive capacity of activated carbon. The relative importance of these synergistic mechanisms appears to depend largely on the characteristics of the wastewater and the nature of the organisms that make up the biomass. Removal of inhibitory substances and bioregeneration are most important with regard to activated sludge treatment of complex wastewaters. More study is needed to elucidate the complex relationship between the presence of an adsorptive surface and the performance of a biological treatment system. Considerable insight could be gained from using simple nutrient solutions containing single organic carbon sources as feeds. If extracellular enzymes can be detected in a biological reactor by virture of the production of metabolic intermediates in the bulk medium, an investigation of the effects of activated carbon on the degradative activity of medium made cell free could be enlightening. (Baker-FRC)
W82-06268

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
M. S. Gould, and E. J. Genetelli.
Water Research, Vol 16, No 5, p 749-753, May, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Heavy metals, *Digested sludge, *Adsorption, *Fate of pollutants, *Regression analysis, Mathematical models, Cadmium, Nickel, Copper, Zinc, Hydrogen ion concentration, Statistical analysis, Temperature effects, Mathematical studies, Enthalpy, Entropy, Model studies, *New Jersey.

The effect of temperature on the binding of Cu, Zn, Cd, and Ni to anaerobically digested sludge was investigated using sludge from the sewage treatment plant at the Marlboro State Hospital in New Jersey. Two different procedures were used for equilibrating and adjusting the pH of heavy metal salt and sludge mixtures. Solids metal content, soluble metal concentration and pH were determined after each equilibration, and results were analyzed by regression analysis using the Statistical Analysis System. The effect of pH, temperature, and solute concentration on heavy metal partitioning with sludge solids was estimated using the van't Hoff equation combined with the Freundlich isotherm and a pH term. Enthalpies for Zn, Ni, and Cd reflect overall endothermic behavior, while results for Cu show that changes in temperature have very little effect. Entropy effects were more suitable than enthalpy effects in explaining the high stability associated with heavy metal/sludge binding. When the temperature is decreased, Zn, Ni, and Cd are solubilized. (Geiger-FRC)
W82-06270

BIOLOGICAL EQUILIBRIUM IN A WASTEWATER RESERVOIR,
Ben Gurion Univ., Sed. Boker (Israel). Lab. for Applied Environmental Microbiology.
A. Abeliovich.
Water Research, Vol 16, No 7, p 1135-1138, July, 1982. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Wastewater lagoons, Reservoirs, *Anaerobic conditions, Algae growth, Oxidation, Municipal wastes, *Israel, Ram reservoir.

Observations were carried out during 1979-1980 in the Ram reservoir, located 2 km east of Beer-Sheva, Israel. The reservoir is 6 meters deep, its area is 20 acres, and it is able to store up to 500,000 cubic meters of effluent from the local municipal oxidation ponds. At present the deep Ram wastewater reservoir behaves as a biologically stable water body with respect to both algal species and algal concentration, in spite of the great diurnal and seasonal variability in water quality and the fluctuations in the various physicochemical and biological parameters measured such as temperature, concentration of biochemical oxygen demand, and ammonia. This stability suggests the presence of factors that prevent any succession of species and development of blooms of any algae. A crucial factor in maintaining aerobic conditions at the surface seems to be water depth. During the summer, as long as the water was deep enough to build a stable thermocline to trap all sulfides, ammonia, and particulate organic matter, the surface water could be safely pumped for irrigation. During the winter, water depth and organic load did not play such a critical role in the reservoir, which was generally anaerobic throughout the water column except for the upper 50-100 cm during the day and 10-25 cm during the night. (Baker-FRC)
W82-06282

OXIDATION OF AQUEOUS PHENOL SOLUTIONS IN THE PRESENCE OF POLYELECTROLYTES,
Wollongong Univ. (Australia). Dept. of Chemistry.
J. Land, and J. Ellis.
Water Research, Vol 16, No 7, p 1139-1145, July, 1982. 3 Fig, 6 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Phenols, Industrial wastes, Toxicity, Chemical coagulation, *Biological wastewater treatment, Chemical reactions, Oxidation, Separation techniques, Polyelectrolytes, Electrolytes.

A study was made of the oxidation of phenols with Fenton's reagent in the presence of polyelectrolyte, to explore the possibility of binding phenol oxidation products to the polyelectrolyte and thus removing them by sedimentation instead of by exhaustive oxidation. The polyelectrolytes selected for study were polyethyleneimine (PEI) and polypropyleneimine (PPI). The precipitation of early oxidation products with PEI provided an alternative to exhaustive chemical oxidation as a means of detoxifying phenolic effluents. The properties of the PEI/oxidized phenol adduct showed some similarities to those of corresponding precipitates obtained with complex humic materials and colored substances. Any substituted phenol which can be chemically oxidized to a 1,2-dihydroxybenzene can be aerially oxidized to products which form an insoluble adduct with PEI. The efficiency of this reaction and its tolerance to varying PH and overdose of PEI increases with increasing molecular weight of the PEI. Although the procedure does not alone reduce the phenol concentration to the desired 0.1 mg/liter for discharge, it does show potential for use as a chemical pre-treatment step of high strength effluents which would otherwise be very harmful to a biological treatment system. (Baker-FRC)
W82-06283

DESIGN CRITERIA FOR A COAGULATION-FLOCCULATION PLANT FOR SEWAGE,
Ministry of Transport and Public Works, Middleburg (Netherlands).
J. Leentvaar, R. E. Roersma, and T. S. J. Ywema.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 1-6, February, 1981. 7 Fig, 9 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Sludge, *Flocculation, *Coagulation, Sewage, Pilot plants.

The aim of this study is to obtain some design criteria for a coagulation flocculation plant that operates with domestic sewage. Parallel to these pilot plant experiments jar-tests were carried out to determine the optimal detention time in the different units and the optimal mixing intensity. Experiments were carried out with raw unsettled sewage of the village of Bennekom, which is mainly of domestic origin. The batch experiments demonstrated that a short and intensive mixing period of sewage and coagulant was favorable, although air burst within the fluid was disadvantageous. It was evident that the rapid mix period in the reactor should be equal to or longer than the mixing time required for complete mixing of the liquid in the tank. In batch experiments a G value of about 700/

sec for 7 s gave the best results. In pilot plant studies it was nearly impossible to measure exactly the G value of the rapid mix unit. Also in the pilot plants a higher G value was advantageous together with a plug flow system. The design of the flocculator involves selection of reactor configuration, velocity grdients and detention time. Previous experiments and general design foundations indicated that square tanks would be favorable. The pilot plant experiments indicated that the total organic carbon removal increased strongly using a floc blanket in the sedimentation tank. The sludge properties were not influenced strongly by the design variations of flocculator or sedimentation tank. (Baker-FRC)
W82-06298

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,
Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06305

WASTEWATER CHARACTERIZATION AND TREATMENT SYSTEM DEVELOPMENT FOR A BLUE CRAB PROCESSING PLANT,
Maryland Univ., College Park. Water Resources Research Center.
F. W. Wheaton, K. M. Lomax, and G. Geiger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256520, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 65, April 1981. 29 p, 4 Fig, 6 Tab, 14 Ref. OWRT A-044-MD(1), 14-34-0001-0122.

Descriptors: Blue crabs, Waste disposal, Seafood, Filtration, *Food-processing wastes, Industrial wastes, *Wastewater treatment, *Crabs, Effluent.

Blue crab processing plant liquid effluent was divided into washdown, hand sink and retort effluent. Each stream was characterized using standard water quality parameters. The wastewater was then subjected to settling, flocculation with alum and chitin, centrifuging, foam fractionation, microscreening or aerobic or anaerobic biological treatment and the resultant water quality determined. Aerobic biological treatment appeared to be the most promising method for meeting water quality guidelines. A wastewater treatment system, consisting of a 60-mesh screen, aerated biological treatment with about a two day retention time and chlorine disinfection, was installed in a blue crab processing plant. The 60-mesh screen significantly reduced total suspended solids (TSS) concentrations but not the BOD sub 5. Aerated biological treatment had reduced BOD sub 5 significantly but had little effect on TSS, volatile and non-volatile solids. Chlorination adequately reduced bacterial populations to below 70 MPN/100 ml. (Author abstract)
W82-06306

WATER REUSE BY METAL REMOVAL FROM INDUSTRIAL PLATING EFFLUENTS,
Rhode Island Univ., Kingston.
F. J. DeLuise, and S. M. Barnett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256538, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1981, 22 p, 11 Fig, 9 Ref. OWRT A-073-RI (1). 14-34-0001-1142.

Descriptors: *Metal-finishing wastes, *Water reuse, Industrial wastes, Flotation, *Microgas dispersions, Effluents, *Wastewater treatment, Copper, Nickel, Chromium, Lead, Zinc.

Microgas dispersions (MGD) have been used in a flotation process to remove copper, chromium, nickel, lead, and zinc from aqueous solutions. Solutions of each metal individually, and mixtures of all the metals were synthetically prepared and treated for removal. Removal of these metals from an actual industrial plating effluent was also studied. Metal removals of up to 100 per cent were obtained from solutions of metals ranging in concentration from 2 to 20 ppm. In addition, plating wastes containing several metals were successfully treated. The most efficient treatment system employed the use of a cationic surfactant with precipitate floatation.
W82-06307

ADSORPTION OF ARSENITE AND ARSENATE ON AMORPHOUS IRON HYDROXIDE,
Arizona State Univ., Tempe. Dept. of Chemistry.
M. L. Pierce, and C. B. Moore.
Water Research, Vol 16, No 7, p 1247-1253, July, 1982. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Arsenic, *Adsorption, Sediments, *Iron hydroxide, *Arsenates, Mining wastes, Industrial wastes, *Wastewater treatment.

This study was undertaken to establish quantitatively the isotherms of arsenite and arsenate adsorption on amorphous iron hydroxide at concentrations which range over four orders of magnitude and a wide range of pH. The adsorption capacity of amorphous iron hydroxide was extremely high for arsenic. Adsorption continued to take place even at the highest concentrations of arsenic studied. For initial arsenic concentrations up to 667 micromoles/liter (50 ppm) removals on the order of 35% at a pH of 4 were found, which amounted to an adsorption of 50 millimoles/g. At low concentrations the isotherms obeyed equations of the Langmuir type. At higher concentrations the adsorption isotherms were linear, indicating the existence of more than one type of surface site on the amorphous iron hydroxide adsorbent. Removal of arsenite and arsenate by amorphous iron hydroxide throughout the concentration range were determined as a function of pH. By careful seletion of the relative concentration of arsenic and amorphous iron hydroxide and pH, removals on the order of 92% can be achieved. (Baker-FRC)
W82-06311

ANAEROBIC FILTER TREATMENT OF MOLASSES DISTILLERY SLOPS,
Agriculture and Forestry Univ., Vienna (Austria). Dept. of Applied Microbiology.
R. Braun, and S. Huss.
Water Research, Vol 16, No 7, p 1167-1171, July, 1982. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Anaerobic digestion, *Food-processing wastes, *Distillery wastes, Industrial wastes, *Wastewater treatment, Anaerobic conditions, Beet molasses.

Laboratory and pilot scale anaerobic filter digestion of beet molasses distillery slops were examined as a method of treating these high-strength industrial wastewaters. The slops used had an average dry matter content of between 4.8 and 63% (w/v). Methane fermentations were initiated by adding sludge from municipal sewage sludge digesters at a concentration corresponding to 30% (v/v) of the water filled filters and a dosage of diluted molasses slops (slops:water = 1:). Initial retention times were set between 4 and 6 days. As the volatile fatty acid concentration decreased, the volumetric load was gradually increased by reducing the retention time. Anaerobic flter treatment proved feasible without either pretreatment or water dilution of the slops at comparably high volumetric loadings and low residence times. There was no difference in the efficiencies of the laboratory and the pilot scale reactors. After continuous operation for 1 year there was no obvious sign of clogging. After dismantling the filter the bacterial sludge was easily rinsed from the packing material. The major part of the sludge was submerged in the void space of the filter packing. A considerable improvement in the gas productivity could be achieved through the addition of iron sulfate. Volumetric loadings of up to 50 kg organic dry matter/cubic meter/day, corresponding to a hydraulic residence time of about 1 day, were achieved. (Baker-FRC)
W82-06312

MODELLING OF THE ACTIVATED SLUDGE PROCESS FOR MICROPROCESSOR-BASED STATE ESTIMATION AND CONTROL,
Helsinki Univ. of Technology, Espoo (Finland).
A. Holmberg.
Water Research, Vol 16, No 7, p 1233-1246, July, 1982. 13 Fig, 5 Tab, 32 Ref.

Descriptors: *Activated sludge process, *Model studies, Computers, *Microprocessors, *Wastewater treatment, Mathematical studies, Biochemical oxygen demand, Oxygen demand, Sludge, Oxygen uptake, Algorithms, *State estimation.

This study was aimed at developing and implementing a microprocessor based estimation and control system for the activated sludge process. A simple dynamic process model suitable for state estimation and control using microprocessors is presented. An estimation algorithm for estimation of the biochemical oxygen demand loads of the influent and effluent was developed and implemented using micro-processors. The algorithm also estimated the concentration of sludge and active mass in the different stages of the process and also sludge growth, using available on-line measurements and the oxygen utilization rate, for which a separate estimation method was needed. An algorithm was developed for on-line determination of the oxygen utilization rate and the oxygen transfer coefficient, which are prerequisites for state estimation. A comparison was made of control strategies. The study comprised two experimental periods at a research plant corresponding in size to a municipal treatment plant for 1000-1500 inhabitants. Control of the activated sludge process is discussed and concluded to be a hierarchical two-level problem. The upper level control actions are aimed at bringing the process to an optimal state of operation. For this purpose verbally formulated control laws are used. On the lower level the control task is to maintain the process in the optimal state. (Baker-FRC)
W82-06324

EFFECTIVE PROJECT MANAGEMENT,
CH2M/Hill Inc., Corvallis, OR.
J. Van Munster.
In: Water/Engineering and Management, Reference Handbook-1982, p 17-18, 20-22, May, 1982. 3 Fig.

Descriptors: *Management, *Planning, Construction, Management planning, Project planning, Personnel management.

Construction management is a system than can be implemented as a professional instrument on water and wastewater projects to complete them successfully in spite of the increasingly complex constraits of the marketplace. The principal phases of construction management program are project setup, which establishes the management tools and guidelines for the project; project delivery analysis and management plan, which defines the management tools and technique for selected delivery approach; and implemeting the contruction management approach, which describes the application of the construction management program during design and construction. The advantages that such a management process offers include a comprehensive management program, which provides continuity from project conception through completion; implementation of a management system specificaly tailored to the particular requirements of the project; a flexible management approach that permits the owner to select only those services needed to augment his capabilities; a single source of responsibility for all phases of the work; the management expertise and needed tools to manage problems associated with communication, responsibility definition or coordination throughout the life of the project; and a potential savings from reduced overhead cost of all team members who have less management responsibility. (Baker-FRC)
W82-06328

EXTRACTION OF PHENOLIC COMPOUNDS AND ORGANIC ACIDS BY LIQUID MEMBRANES,

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Exxon Research and Engineering Co., Linden, NJ. Corporated Research Technology Feasibility Center.
R. E. Terry, N. N. Li, and W. S. Ho.
Journal of Membrane Science, Vol 10, No 2/3, p 305-323, 1982. 11 Fig, 5 Tab, 12 Ref.

Descriptors: *Separation techniques, *Perselective membranes, *Membrane processes, Phenols, *Organic acids, *Wastewater treatment, Membranes, Industrial wates. Semipermeable membranes, Permeability, Model Studies, Mass Transfer.

The application of liquid membrane technology in removing phenolic and organic acid contaminants from wastewater streams is described. As the phenolic compounds and organic acids permeate throught the liquid membranes into emulsion droplets, they react with caustic, the main reactive agent, and become ionized. The ionized species which cannot permeate the liquid membranes are held in the emulsion droplets. A mass transfer model is presented which describes the extraction process. More than 99% of phenol and cresol can be extracted in see than 1 minute, while acetic and propionic acids can be extracted at a much slower rate. The phenolic compounds are extracted at a pH of 7, while the acids can only be extracted low pH. The extraction rates for acetic acid and phenol are the same in individual-compound and binary-mixture permeations. (Geiger-FRC)
W82-06331

REMOVAL OF ZEOLITE TYPE A DURING PRIMARY SEDIMENTATION AND ITS EFFECT ON METAL REMOVAL,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. C. Rossin, R. Perry, and J. N. Lester.
Water Research, Vol 16, No 7, p 1223-1232, July, 1982. 2 Fig, 6 Tab, 26 Ref.

Descriptors: *Zeolites, *Wastewater treatment, Zeolite process, Sedimentation, Lead, Copper, Zinc, Chromium, *Heavy metals, Suspended solids.

The removal of zeolite type A in a pilot scale primary sedimentation system operating in the field, and its effect on metal removal, are reported. With one zeolite free pilot plant acting as a control to the other it was also possible to determine the effect of zeolite on suspended solids and heavy metal removal over a range of hydraulic loadings. At both influent concentrations of zeolite studied (30 and 60 mg/liter) zeolite removal was substantial under all conditions. No evidence of enhanced removal of suspended solids in the presence of zeolite was noted. Removals of lead, zinc, copper and chromium were slightly enhanced in some experiments. The observed improvements in metal removal appeared to be strongly influenced by the sewage matrix. (Baker-FRC)
W82-06338

OPERATING COLLECTION SYSTEMS UNDER FISCAL STRESS,
Charlotte-Mecklenburg Utility Dept., NC.
C. L. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 23-25, May, 1982.

Descriptors: *Financial aspects, *Management, Personnel management, Management planning, Planning, Mechanical equipment.

Municipal managers have been forced into a painful reassessment of existing operations due to the current conditions of fiscal retrenchment at the national level, coupled with the fact that local revenue sources have reached practical political limits. In Charlotte, North Carolina, three critical objectives were sought: to minimize redundancy and maximize efficiency of existing cleanup programs through development of a problem-history-based preventive maintenance effort; to re-examine existing methods of personnel and equipment usage with the aim of detecting and eliminating nonutilized time and correspondingly increasing productivity and efficiency; and to develop comprehensive management information systems that would facilitate implementation and monitoring of the other two objectives. While this effort did not reach all available alternatives in dealing with budgetary retrenchment, there was no question that the effort would continue to pressure for further reductions in the cost of services. (Baker-FRC)
W82-06340

ROTATING BIOLOGICAL CONTACTOR SCALE-UP AND DESIGN,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and D. F. Kincannon.
In: Water/Engineering and Management, Reference Handbook-1982, p 48, 50-54, May, 1982. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, *Rotating biological contactor, Kinetics, Biochemical oxygen demand, Oxygen demand.

Experience gained over the past ten years in the scale-up and design of rotating biological contactor systems is reviewed. Performance data, operating information and kinetic data can be obtained from bench and pilot scale RBC systems for designing full scale systems. One major consideration in using RBC systems is whether the removal efficiency is dependent on the substrate concentration of the wastewater or the hydraulic flow rate. In fact, both flow rate and organic concentration exhibit definite relationships with substrate removal rate and efficiency. Another design approach considers the amount of soluble substrate removed per unit of surface area for each stage of a multistage RBC system. Any design method based on zero, first or second order rate kinetics will be limited to loading conditions within a specific loading range for design of RBCs. The total organic loading design method can accurately predict the amount of biochemical oxygen demand removed per applied BOD loading regardless of apparent zero, first or second order kinetics. The excellent fit of the Monod-type relationship to BOD removed vs. BOD applied allows prediction of BOD removal for any applied loadings desired by application of monomolecular kinetic analysis. The primary mechanism of oxygen transfer in RBC systems appears to be transfer from the gas phase into the liquid flowing over the media during rotation. To effectively accomplish scale-up of RBCs from pilot data, the oxygen transfer capabilities and limitations of the full scale systems must be defined. (Baker-FRC)
W82-06344

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,
Los Angeles County Sanitation Districts, Whittier, CA.
W. E. Garrison, C. A. Nagel, and R. S. Easley.
In: Water/Engineering and Management, Reference Handbook-1982, p 68-72, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Sludge digestion, *Design criteria, Anaerobic conditions, Anaerobic digestion, Digestion, Biological treatment, Biodegradation, Sludge, Wastewater treatment, Sludge disposal, Digested sludge, Fuel.

Various design and operting principles used over recent years in the Sanitation Districts of Los Angeles County have demonstrated that anaerobic digestion can be a very reliable and safe unit operation in a modern sewage treatment plant. The benefits derived in energy return and lack of plant nuisance make the effort rewarding. Rapid acceleration of energy costs in future years will make the anaerobic digestion of sludge solids a vital part of many modern sewage treatment systems. The basic advantages of such a plan include energy recovery, reduced odor potential in subsequent handling, reduced health risk for composting and recycle, and sludge storage and equalization for subsequent dewatering stages. The California plant described treats 15 cubic meters/ sec of sewage in an advanced primary system and currently produces 160,000 cubic meters per day of digester gas, of which 50% is used in the plant and the balance sold to an adjacent oil refinery. Digester gas is used by reciprocating engines to drive large pumps and genertors and as a fuel source in boilers to produce steam for digester heating. Specifics are discussed for the master plan for circular digesters, digester sizing, the mixing system, the heating system, the cleanout system, and safety features. (Baker-FRC)
W82-06347

ROTATING BIOLOGICAL CONTACTOR SYSTEM DESIGN,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and E. D. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 578-588, June, 1982. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Design criteria, *Wastewater treatment, *Rotating biological contactor, Biochemical oxygen demand, Oxygen demand, Wastewater treatment facilities.

The practical application of Wu's model for the prediction of soluble biochemical oxygen demand removal in rotating biological contactor systems is discussed extensively for various operating conditions. In the predictive model wastewater with or without pretreatment is fed on a once-through basis to RBC systems for biological oxidation of waste matter. Recycling of RBC effluent back to the early stages of the system has not been practiced, as no significant increase in treatment efficiency could be related to this practice. Apparently the major factors which directly influence the efficiency of RBC wastewater treatment systems are: influent wastewater characteristics, flow rate and surface hydraulic loading, disc rotation speed, submerged disc depth, liquid retention time, and wastewater temperature. By using the proposed mathematical model, design of mechanical-drive RBC plants for carbonaceous removal can be easily and precisely performed. Calculating the required surface hydraulic loading rate, variables such as influent soluble BOD concentration, wastewater temperature, and others can be thoroughly investigated and determined. The total disc surface area required is equal to the design wastewater flow divided by the calculated surface hydraulic loading. The precision for the percentage of biochemical oxygen demand removal resulting from the use of this model was about 4.64% for the data sets tested. (Baker-FRC)
W82-06355

NITRIFICATION KINETICS AND ITS RBC APPLICATION,
Norton AFB, CA.
C. -S. Huang.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 473-487, June, 1982. 9 Fig, 39 Ref.

Descriptors: *Nitrification, Kinetics, *Wastewater treatment, Ammonia, Nitrogen, Nitrogen removal, *Rotating biological contactor, Filtration.

A stationary, inclined plate on which a nitrifying biological film was developed was used to investigate the nitrification surface reaction model, and a second study on the bench scale was performed with a rotating biological contactor to see whether the findings of the first study were also applicable to the rotating biological film process. Based on the results of these two studies, it was concluded that the nitrification process follows a zero-order reaction both in stationary fixed-film systems and in rotating fixed-film systems. The pseudohomogeneous surface reaction model can be applied to both trickling filter systems and RBC systems. That is, the nitrification efficiency in a trickling filter process depends on the characteristics of the packing media used and the reciprocal of the two-thirds power of the hydraulic loading. Thus, in a RBC nitrification system, ammonia-nitrogen removal is a function of the square root of the rotation speed up to a certain speed. The active microbial film in a nitrifying RBC unit may be

estimated by locating the optimum ammonia-nitrogen removal rotation speed and the corresponding liquid film thickness at that rotation speed. The RBC unit used in this study has an active (or effective) slime thickness of about 72 micrometers. (Baker-FRC)
W82-06356

DESIGN APPROACH TO DUAL-POWER AERATED LAGOONS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 532-548, June, 1982. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Design criteria, *Aerated lagoons, Lagoons, Oxidation, *Wastewater treatment, Biochemical oxygen demand, Oxygen demand, Kinetics.

Completely and partially suspended lagoon cells are defined and their use in dual-power level, multicellular systems is discussed. A procedure is presented for designing a dual-power level, multicellular aerated lagoon system on a rational basis using biokinetic coefficient data. The aeration cells can be designed as inverted, truncated pyramids. Center depth should be no less than 3 meters, and for many earth materials in which a cell is constructed, a slope no steeper than 1:3 (vertical:horizontal) should be used. Influent pipes to all the aeration cells should discharge at a shallow depth below the aerators. Effluent from the first cell should be withdrawn from behind a surface baffle. Effluents from all the other aeration cells should be withdrawn at the surface without surface baffling so as to avoid retention of any algae that might be generated in the system Riprap or a concrete apron should be placed at the water line to prevent erosion. The size combination selected for the design should reflect the following considerations: capital cost, operating cost, algal growth potential, and depth of sludge accumulation in the partially-suspended cells. (Baker-FRC)
W82-06358

PERFORMANCE OF MODIFIED CHLORINE CONTACT CHAMBER,
Worcester Polytechnic Inst., MA. Dept. of Civil Engineering.
F. L. Hunt, and Z. Vogiatzis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 549-561, June, 1982. 6 Fig, 8 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Disinfection, *Chlorine, *Chlorination, Economic aspects, Baffles, Design criteria.

A field study was conducted to determine the effectiveness of perforated baffles was to increase the hydraulic efficiency and lower the required dosage of chlorine. Field evaluations were conducted at the Maynard, Massachusetts, Municipal Wastewater Treatment Plant Chlorine Contact Chamber. This study did not distinguish between applied chlorine dose and actual chlorine dose. The chlorine demand is considered to be negligible. In addition no distinction was made between a free chlorine residual disinfection response and a combined chlorine residual disinfection response. The findings suggest that tracer responses from the model unit and the field unit were similar. Future model scale studies to further quantify disinfection process responses while varying disinfectant types or modes of application of the model unit can be attempted. Field tracer responses in the unmodified and modified field units correspond closely with the curve generated through a specific equation. Use of the batch reactor data and tracer data is therefore acceptable for the chlorine contact chamber unit evaluated in this study. Tracer data comparing the unmodified and modified CCC units show an improvement in the modified unit. Installations of these baffles in this CCC unit parallel the performance of a CCC unit that has a length-of-flow to width ratio of 25/1. Disinfection efficiency was improved 24% in the modified unit. About a 10% lower chlorine dose was needed. A cost evaluation indicates that these baffles should be cose effective, with the percentage saved depending on the average applied dose. In addition to cost savings, the benefit of lowering chlorine usage and lessening the release of chlorinated organics in wastewater effluents will reduce potential pollution dangers. (Baker-FRC)
W82-06359

EVALUATION OF THE 'LECTRO CLEAR Z' ELECTRO-COAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREATMENT.
Western Industrial Labs. Ltd., Edmonton (Alberta).
Environment Canada, Ottawa, Environmental Protection Service, Report No EPS 4-WP-82-1, January, 1982. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Water quality control, *Meat processing industry, Electrical equipment, *Coagulation, Suspended solids, Biological oxygen demand, Industrial waste, Sanitary engineering, Design criteria, Process control, Engineering, Civil engineering, Cost analysis, Industrial plants, Food processing industry, Catchment basins, Discharge capacity, Economic evaluation, Wastewater facilities, Sewer systems, *Electro-coagulation.

Serious sewage treatment problems were encountered in Lethbridge, Alberta, due to its large number of food processing plants. An eight-week detailed evaluation was conducted in 1980 to assess the operation of a Lectro Clear Z (LCA) unit installed at a Lethbridge meat packing sewage system. As a result of this evaluation, it was determined that the LCZ unit could achieve BOD and suspended solids reduction of about 55-65% on the total existing catch basin effluent. In addition to achieving an acceptable level of treatment, it was confirmed that by-product recovery from the LCZ skimmings was possible. While the subject plant had an existing pretreatment basin, new plants or plants without existing basins must consider some kind of sedimentation and equilization for preparing wastewater prior to the LCZ unit. Further, unexpected occurrence and persistence of electrical problems for the LCZ unit suggests that tighter manfacturing specifications, installation, and operation of the electrical components should be considered. Specific recommendations are given for various topics concerning LCZ operation, including wastewater conductivity, pH adjustment, LCZ influent temperature, hydrogen sulfide formation, and turbulence in the coagulation section of the unit. An economic evaluation of the system was also made. (Zielinski-MAXIMA)
W82-06378

EVALUATION OF BIOLOGICAL NITRIFICATION - DENITRIFICATION AT PENTICTON, BRITISH COLUMBIA,
International Environmental Consultants Ltd., Islington (Ontario).
K. L. Murphy, and R. W. Wilson.
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-10, 1981. 72 p, 13 Fig, 13 Tab, 33 Ref, 2 Append.

Descriptors: *Biological wastewater treatment, *Municipal wastewater, Design criteria, *Denitrification, *Sanitary engineering *Cost analysis, Biological treatment, *Wastewater treatment, Wastewater, Process control, Nitrogen removal, *Nitrification, Organic carbon, Engineering, Civil engineering, Water quality control, Water quality, Activated sludge.

A study was undertaken to review proven methods for removing biological nitrogen (N) from municipal wastewater, to select suitable design parametrers, and to prepare process designs and capital/operating cost estimates for process alternatives appropriate for Penticton, British Columbia. Detailed process option evaluations were made for: two-sludge nitrification plus denitrification; one-sludge post-denitrification; and one-sludge pre-denitrification. Process designs were based on achieving up to 5 mg/liter nitrate-N and 1 mg/liter TKN in the treated effluent throughout the year. The pre-denitrification process was found to be the most cost effective, the design being based on a 20-day solids residence time (SRT) for the nitrification basin and a 10-day SRT for the denitrification basin to ensure efficient N removal at a minimum operating temperature of 8 degrees. The cost of combined carbon and N removal be pre-denitrification was estimated to be about 25% higher than for carbon removal by activated sludge, and 10% higher than for carbon removal and nitrification alone. Land disposal, ammonia stripping, and ion exchange were estimated as more costly than biological N removal methods. General costs are given for N removal at wastewater treatment facilities handling 5000-45000 cu m/day. (Zielinski-MAXIMA)
W82-06379

PILOT SCALE ASSESSMENT OF THE BIOLOGICAL FLUIDIZED BED PROCESS FOR MUNICIPAL WASTEWATER TREATMENT.
Dearborn Environmental Consulting Services, Mississauga (Ontario).
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-11, 1981. 148 p, 73 Fig, 43 Tab, 69 Ref.

Descriptors: *Biological wastewater treatment, Pilot plants, *Fluidized bed process, *Municipal wastewater, *Wastewater, *Oxidation, *Wastewater treatment, Nitrification, Biological oxygen demand, Activated sludge process, Suspended solids, Municipal wastes, Sewer systems, Wastewater facilities, Fluidized beds, Ammonia, Process control.

Pilot-scale studies of the oxygenic biological fludized bed process demonstrated that the system is a technically-feasible alternative to carbon oxidation and nitrification of municipal wastewaters. The design organic loading of the bed is limited by the ability of the process to remove suspended particulates. A treated effluent containing below 15 mg/liter filterable BOD-5 was consistently produced at a loading rate of 10 kg BOD-5 cu m/day (an order-of-magnitude higher than for conventional suspended growth systems (CSGS). Operation at a volumetric loading similar to CSGS was necessary to attain below 15 mg/liter total BOD-5 without effluent polishing, due to the contribution of suspended solids in the final effluent BOD-5. The bed responded rapidly to influent condition changes and was less susceptible to influent disturbances than the activated sludge and rotating biological contactor processes in terms of effluent filterable organic carbon concentration. Significant deterioration occurred in effluent quality in terms of suspended solids levels under diurnally-varying flow/concentration conditions. Separate stage nitrification studies did not show the order-of magnitude increases in volumetric ammonia oxidation rates claimed by other workers. Despite apparent limitation concerning suspended solids removal during separate stage nitrification of high quality secondary effluent, the process demonstrated a potential for use in several wastewater treatment areas. (Zielinski-MAXIMA)
W82-06380

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,
Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-7E, February, 1982. 130 p, 7 Fig, 5 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

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Joint treatment of industrial and municipal wastewaters requires a system for computing equitable charges to treatment facility users. A computer program (TAREP) has been developed for this purpose. Information is presented for using the TAREP program to establish a distribution of costs for wastewater treatment. Also included are instructions for coding data, a description of the TAREP subroutines, the program (in FORTRAN) taken from a run on the University of Montreal's CYBER 173, and the results of that run. TAREP is applicable in municipalities where there is joint industrial /municipal wastewater treatment, and can be used to establish charges to ratepayers where treatment facilities are already in place, as well as for preliminary studies leading to the construction of such facilities (thereby enabling municipalities and users to judge whether joint treatment is economically sound). The principles underlying TAREP and case histories conducted using this program are described in the first volume of this 2-volume set. (Zielinski-MAXIMA)
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,
Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-6E, February, 1982. 209 p, 17 Fig, 1 Tab, 39 Ref, 14 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

Joint treatment of industrial and municipal wastewater raises the problem of establishing equitable charges to treatment facility users, since industrial wastewaters carry higher contaminant loads than domestic wastes. The technical background, development, and testing of a computer program for the allocation of user costs for wastewater treatment systems are described. The second volume of this 2-volume set represents the user's manual for this program (TAREP). User charges provided by the program are based on wastewater volume and pollutant loading. Twelve cost factors are provided for use in the program (4 each relating to current users, future industrial use, and property), which can be used/discarded depending on the case under consideration. Case studies were conducted for the program in Waterloo and Granby, Quebec. Data used in these studies included: wastewater flows from various sources (domestic, industrial, groundwater infiltration, public uses, stormwater runoff); average pollutant loadings in such flows; design capacities of the treatment plants and sewers; costs associated with construction/operation/maintenance of facilities; property assessments and areas; saver type serving each property. A program was also developed to evaluate the sensitivity of the charges generated by TAREP to cost breakdown changes. Estimated implementation costs for TAREP are $4500 plus $0.11/inhabitant. (Zielinski-MAXIMA)
W82-06382

APPLICATION OF ULTRAVIOLET DISINFECTION IN A TERTIARY WASTEWATER TREATMENT PLANT,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
K. W. A. Ho.
Research Report No 87, January, 1982. 53 p, 10 Fig, 10 Tab, 31 Ref, 2 Append.

Descriptors: *Ultrviolet radiation, *Tertiary wastewater treatment, *Municipal wastewater, *Sewage bacteria, *Economic evaluation, *Mathematical models, Disinfection, Wastewater treatment, Chemical oxygen demand, Prediction, Municipal wastes, Wastewater disposal, Nitrification, Chlorination, Economic aspects, Economic feasibility, Water treatment, Coliforms.

Applicability of ultraviolet (UV) disinfection technology was investigated for a well-nitrified sand-filtered municipal sewage effluent. Disinfection by UV irradiation is an effective and cost-competitive alternative to a chlorination plus dechlorination (CPD) process. The UV disinfection unit employed consistently reduced effluent total and fecal coliforms to 2500 and 200 per 100 ml, respectively, when operated according to maufacturer's recommendations. In addition, the effluent chemical oxygen demand concentration was found to be a useful surrogate parameter for predicting UV disinfection efficiency, as affected by effluent quality changes. Costs (amortized capital plus operating) for UV disinfection in the sewage effluent was estimated at $0.0433-0.0467/cu m, a cost about 1.2-1.3 times that for a CPD process. This cost, however, is only 49% and 55% that of ozone and chlorine dioxide disinfection costs, respectively. The UV unit quartz sheaths were hand-brushed every 24 hours of continuous operation to free them from fouling by deposits, indicating the need for an automatic sheath wiping system for future UV disinfection units. Development of a semi-mechanistic model for UV disinfection data analysis and its application are reported. (Zielinski-MAXIMA)
W82-06390

A SURVEY OF AERATED LAGOON PERFORMANCE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
W. Lewandowski, and B. Bradley.
Research Publication No 85, October 1981. 58 p, 28 Tab, 3 Ref.

Descriptors: *Aerated lagoons, *Organic loading, *Wastewater treatment, *Stabilization ponds, Surveys, Lagoons, Biological oxygen demand, Aeration, Oxidation, Aerators, Evaluation, Organic Matters, Organic wastes, Suspended solids, Stabilization lagoons, Pretreatment of Water, Wastewater facilities, Water quality control.

Construction of an aerated cell (AC) ahead of a waste stabilization pond (lagoon) system can be used to reduce the organic load to the existing system. Five wastewater treatment systems were surveyed to determine if completely mixed ACs or facultative ACs represent viable means of pretreatment for reducing organic loads to existing stabilization ponds. It was determined that substantial reductions in BOD-5 and suspended solids are achieved by the pretreatment ACs; however, the pretreatment cells do not prevent anaerobic conditions in the stabilization ponds that follow during ice and snow cover periods. Hence, conversion of the ponds to aerated facultative ponds (through sub-surface aeration or post-treatment for hydrogen sulfide removal) may be necessary. Further, with respect to ammonia-nitrogen, the pretreatment cells will not achieve appreciable reductions unless they are modified to achieve complete nitrification throughout the year. The aeration equipment performed satisfactorily at loads close to the design organic load of 463 kg BOD-5/day (1020 lbs BOD-5/day). At comparable organic loads, treatment efficiency with respect to BOD-5 removal is quite similar for both pretreatment processes, but facultative ACs usually produce effluents with considerably lower effluent suspended solids concentrations. (Zielinski-MAXIMA)
W82-06391

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,
Canviro Consultants Limited, Kitchener (Ontario).
E. E. Shannon, H. D. Monteith, and A. K. W. Ho.
Research Report No 82, February 1982. Ontario Ministry of Environment, Toronto. 102 p, 3 Fig, 20 Tab, 70 Ref, 2 Append.

Descriptors: *Organic compounds, *Biological wastewater treatment, *Monitoring, *Chemical industry, *Industrial waste water, Wastewater treatment, Raw sewage, Industrial plants, Industrial wastes, Chemical analysis, Gas chromatography, Mass spectrometry, Quantitative analysis, Fate of pollutants, Path of pollutants, Trace levels, Activated sludge process, Anaerobic digestion.

Research was carried out in two study phases, representing the first Ontario effort to monitor the fate of trace organic contaminants in their passage through a conventional activated sludge plant. In the first phase a field sampling program was conducted in a full-scale plant receiving about 26% by volume of its raw sewage from a single organics manufacturing plant. Analysis of sample extracts by gas chromatography/mass spectrometry detected benzothiazole, diethyl phthalate, dioctyl phthalate, diphenylamine, 2-methyl-mercapto benzothiazole, and aniline as the major organics in all influent, effluent, and sludge samples. In the second phase, an attempt was made to determine the fate of these six contaminants passing through two pilot-scale activated sludge reactors and a pilot-scale anaerobic digester, While mass balances for the six compounds around the three reactors were unattainable due to poor quantitative measurement accuracy, results strongly indicated that aniline removal occurred during activated sludge treatment and dioctyl phthalate accumulated in the activated sludge solids. A more extensive effort towards extraction and analytical methods development is recommended to improve quantitative results before carrying out any further organics monitoring program.(Zielinski-MAXIMA)
W82-06392

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W82-06405

DETERMINATION OF REACTION RATE CONSTANT AND TEMPERATURE COEFFICIENT CONSTANT FOR DADAR SEWAGE, BOMBAY,
Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 107-110, June, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Fate of pollutants, *Mathematical equations, *Temperature effects, *Wastewater treatment, *Microbial degradation, *Graphical methods, Biochemical oxygen demand, Organic wastes, Inorganic compounds, Industrial wastes, Domestic wastes, Biodegradation, Bombay, India.

When industrial and domestic wastes are discharged into water bodies, they are slowly degraded and stabilized by microorganisms, leading to self-purification of water bodies to some extent. The reaction rate of stabilizing such organic and inorganic wastes in what is known as a bochemical oxygen demand (BOD) reaction is temperature dependent. The validity of this first order reaction rate constant under the conditions of the Dadar sewage treatment plant of Bombay, India was determined at different sets of temperatures. The temperature coefficients for Dadar sewage were found to be 1.044, 1.049, and 1.039 for dilution factors of 1:40, 1:50, and 1: 62.5, respectively. Little variation was noted in the reaction rate constant at different sets of temperatures under Indian conditions. The average reaction rate constants were calculated to be 0.19, 0.32, and 0.38 for 20, 27, and 37 degrees, respectively. (Geiger-FRC)
W82-06438

ON-SITE WASTEWATER MANAGEMENT--RECENT TRENDS,
T. Viraraghavan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 60-61, February, 1981. 8 Ref.

Descriptors: *Wastewater management, *Developing countries, India, Rural areas, Septic tanks, *Wastewater disposal, Sanitary engineering.

The 'Management District' concept may help implement a long-term program of on-site wastewater disposal in rural areas of developing

countries. A management district is a publicly owned and operated utility which assumes responsibility for on-site sewers in a designated area. This involves site surveys, septic tank and disposal field design installation of new systems, replacement of faulty systems, monitoring, inspection, and maintenance. The author proposes that India be divided into four such districts for a three-phase study of the system. The phases would consist of: (1) analysis of experiences in the U. S. and Canada and determination of feasibility, (2) site-specific analyses, and (3) implementation. (Cassar-FRC)
W82-06439

GENERATION AND UTILIZATION OF OZONE IN WASTE WATER TREATMENT,
Roorkee Univ., (India).
A. K. Mittal, I. Mehrotra, and R. P. Mathur.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 82-84, February, 1981. 4 Fig, 10 Ref.

Descriptors: *Ozonation, *Ozone, Advanced wastewater treatment, Disinfection, *Wastewater treatment, Tertiary wastewater treatment, Water treatment, Organic compounds, Industrial wastewater treatment, Oxidation.

An ozone generator based on the electric discharge principle was developed and tested for use in treating wastewater effluents, industrial wastes, and water supplies. The equipment, with a 2400 sq cm average electrode surface area and discharge gap of 2.5 mm, was performance tested to produce a set of curves correlating oxygen feed rate with power requirements for desired ozone concentrations and flow rates. The most economical ozone production was 30 mg per liter ozone at a rate of 5 g per hour at an oxygen feed of 190 liters per hour and power requirements of 109 W. Beyond this point slight increases in concentration required sharp increases in power requirements. A graph of ozone production vs. flow rate at voltages from 100 to 150 V was also prepared. (Cassar-FRC)
W82-06442

MEMBRANE SEPARATION PROCESSES,
Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
H. Strathmann.
Journal of Membrane Science, Vol 9, No 1/2, p 121-189, 1981. 29 Fig, 6 Tab, 121 Ref.

Descriptors: *Membrane processes, *Filtration, *Separation techniques, Reviews, Microfiltration, Ultrafiltration, Reverse osmosis, Electrodialysis, Dialysis, Wastewater treatment, Water treatment, Industrial water, Industrial wastewater treatment, Food-processing wastes, Potable water, Chemical wastewater, Metal-finishing wastes, Pulp and paper industry, Desalination, Advanced wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment, Demineralization.

A comprehensive review of membrane separation processes includes fundamentals, chemical engineering aspects, practical experiences, and future perspectives. The principles and applications of separation processes (microfiltration, ultrafiltration, diafiltration, reserve osmosis, electrodialysis, and gas separations) are given. Commercial membranes, their structure, properties, and uses, are discussed in detail. Membrane processes are used in production of potable and industrial water. Microfiltration produces ultrapure water for the electronics industry and removes undesirable substances from process water for chemical, food, and drug industries. Ultrafiltration produces ultrapure water for the electronics industry and sterile, pyrogen-free water for the chemical and drug industries. Reverse osmosis desalinizes sea and brackish water, removes hardness from boiler feed water, deionizes water for electronics and electroplating industries, and sterilizes and deionizes water for the chemical and drug industries. Electrodialysis desalinizes brackish water and softens industrial process water. These processes are also useful in treating industrial and municipal wastewaters. Microfiltration is used for filtration of colloidal and turbid solutions. Ultrafiltration separates oil/water mixtures, recovers electrophoretic paints from rinse water, recovers proteins from food-processing wastewaters, recovers polyvinyl chloride from textile wastewaters, recovers lanolin from wool rinse water, and treats pulp and paper effluents. Reverse osmosis recovers sustances from food-processing industries, treats effluents from the pulp and paper industry, provides secondary or tertiary municipal wastewater effluent treatment, and desalts industrial effluents. Electrodialysis removes heavy metal ions from metal plating rinse water and removes salts from food-processing and industrial effluents. (Cassar-FRC)
W82-06445

AMMONIA NITROGEN REMOVAL IN FACULTATIVE WASTEWATER STABILIZATION PONDS,
Culp/Wesner/Culp, Denver, CO.
A. Pano, and E. J. Middlebrooks.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 344-351, April, 1982. 3 Fig, 10 Tab, 10 Ref.

Descriptors: *Ammonia, *Nitrogen, *Stabilization ponds, Nitrification, *Wastewater treatment, Mathematical equations, *Biological wastewater treatment.

Although ammonia removal from wastewaters is currently associated almost entirely with advanced wastewater treatment processes, ammonia nitrogen removal may be accomplished in facultative wastewater stabilization ponds. Methods by which such removal may take place include gaseous ammonia stripping to the atmosphere ammonia assimilation in algal biomass, and biological nitrification. Low concentrations of nitrates and nitites in pond effluents indicate that nitrification does not normally account for any significant proportion of the ammonia nitrogen removal. Analysis of data from three wastewater stabilization pond systems located in different areas of the United States showed that annual ammonia nitrogen removals above 90% were obtained. There was a statistically significant relationship between ammonia nitrogen removal in the primary ponds and the pH value, water temperature, and hydraulic loading rate. An equation for the ammonia nitrogen removal in facultative stabilization ponds is developed which incorporates water temperature, pH value, and hydraulic loading rate as variables. Application of this model to the ponds showed that ammonia nitrogen removal increases as the pH value, detention time, and temperature increase. At 20 C with a pH value of 8.0 in the primary pond (8.4 in the other ponds), and at a 100-day detention time, the predicted ammonia removal is about 98%. Model coefficients decrease with temperatures above 20 C, probably as a result of thermal stratifiction in the pond system and poor mixing conditions. Verification of the model showed excellent agreement between model predictions of ammonia nitrogen removals and data collected from the test systems and from facultative wastewater stabilization ponds with configurations and climatic conditions similar to those used for model development. (Carroll-FRC)
W82-06454

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,
British Columbia Univ., Vancouver.
D. S. Mavinic, and D. A. Koers.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 352-360, April, 1982. 10 Fig, 20 Ref.

Descriptors: *Nitrogen, *Aerobic digestion, *Sludge digestion, Nitrification, Denitrification, *Wastewater treatment, Temperature effects, Activated sludge, Sludge disposal, Sludge excess, *Fate of pollutants.

Little literature is available pertaining to design and operating criteria for aerobic digestion systems handling waste activated sludges. This study investigated nitrogen mineralization, nitrification, and denitrification processes occurring in several modes of digestion at temperatures of 20 C, 10 C, and 5 C. The modes of digestor operation studied included batch feeding and aeration; once-daily feed with once-daily, manual decanting; and continuous feed with continuous, automatic decanting. Organic nitrogen measurements of aerobic digestor mixed liquor were found to be practically constant, per unit of cell mass, for all systems and sludge ages. This constant organic nitrogen content of the cell mass, together with the absence of organic nitrogen in the supernatants, suggests that volatile solids destruction in aerobic digestion results in almost 100% mineralization of organic nitrogen to ammonia in solution. As a result, a considerable amount of soluble nitrogen may be returned to the treatment process with the digester supernatant. Considerable nitrification and denitrification were found to occur in all systems and at all temperatures. While nitrification and denitrification decreased with decreasing temperature and sludge age in the continuous feed system, a markedly higher degree of nitrification and denitrification occurred at 5 C than at higher temperatures in the daily feed, manual decant system. Similar trends were observed for the batch systems. Further research with respect to the effects of pH on these nitrogen processes and studies involving a more complete nitrogen balance are recommended. (Carroll-FRC)
W82-06455

NITROGEN DYNAMICS IN WASTE STABILIZATION PONDS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and C. B. Avci.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 361-369, April, 1982. 8 fig, 4 Tab, 22 Ref.

Descriptors: *Nitrogen compounds, *Wastewater treatment, *Stabilization ponds, Mathematical models, Nitrogen removal, Sedimentation, Ammonia.

Nitrogen transformations and removal mechanisms in a waste stabilization pond were investigated via a time-variable model. The relative importances of ammonia volatilization, organism uptake, and sedimentation as nitrogen removal mechanisms were evaluated. The model developed for use in this study is designed to evaluate the percent reduction in waste load which occurs in the stabilization pond, rather than the percent reduction in concentration of pollutants. The primary mechanism of nitrogen removal was found to be the settling of organic nitrogen and subsequent accumulation of non-biodegradable material in the sediment zone. These solids consist of non-living organic material, including bacterial and algal cells. Cell growth results in the conversion of soluble inorganic nitrogen to particulate organic nitrogen, which is removed by sedimentation. Biological activity is the primary mechanism for the removal of ammonia, although ammonia volatilization may contribute to total nitrogen removal at high pH, temperature, and concentrations of ammonia-nitrogen. While some nitrogen removal is achieved through denitrification, the amount of nitrogen removal that can occur through this mechanism is limited by the amount of nitrate introduced into the pond via the influent, which is generally very small. Dynamic models such as the one used in this study can indicate the form of nitrogen or other constituents in the pond effluent. In conjunction with solids removal techniques, this information can be used to develop predictions of overall treatment efficiency and operation and maintenance requirements relating to solids loadings and frequency of filter backwashing. (Carroll-FRC)
W82-06456

INDUSTRIAL WASTES AS CARBON SOURCES IN BIOLOGICAL DENITRIFICATION,
Washington State Univ., Pullman.
J. R. Skrinde, and S. K. Bhagat.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 370-377, April, 1982. 6 Fig, 11 Tab, 17 Ref.

Descriptors: *Denitrification, *Organic carbon, *Industrial wastes, *Biological wastewater treat-

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ment, Carbon Methanol, Wastewater treatment, Activated carbon, Anaerobic digestion.

Wastewater contributions of nitrogen, in the form of nitrates, organic nitrogen, and ammonia, have led to eutrophic and toxic conditions in many waterways. Biological nitrification and denitrification appear to be the most promising processes for removing nitrogen from wastewaters. The addition of an organic carbon source, typically methanol, is generally required for denitrification. This study investigated the effectiveness of four industrial waste products (corn silage derivative, excess yeast from a brewery, liquid whey waste from a dairy, and spent sulfite liquor from a paper mill) as alternatives to the relatively expensive methanol. These industrial waste products were all found to be suitable carbon source alternatives and yielded denitrification efficiencies comparable to those observed with methanol. Yeast, methanol, and spent sulfite liquor were found to yield optimum denitrification with a chemical oxygen demand to nitrate-nitrogen ratio of 3 to 1. The rate of denitrification decreased linearly at lower ratios for these three carbon sources. Increased levels of denitrification result in additional 5-day biochemical oxygen demand (BOD) and, to some extent, suspended solids in the effluent. A compromise between desired levels of nitrate and of 5-day BOD in the effluent may be necessary. Denitrification was achieved efficiently and effectively in a fluidized anaerobic activated-carbon system, which required shorter detention times to effect high levels of denitrification than those required by other biological denitrification systems. (Carroll-FRC)
W82-06457

COMPARISON OF BOD RELATIONSHIPS FOR TYPICAL EDIBLE AND PETROLEUM OILS.
Kraft, Inc., Glenview, IL.
J. C. Groenewold, R. F. Pico, and K. S. Watson.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 398-405, April, 1982. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Food-processing wastes, *Biochemical oxygen demand, Grease, *Petroleum products, Industrial wastewater, Rregulations, *Wastewater treatment, Wastewater management, Biodegradability.

Although food processing plant wastes are generally recognized to be completely compatible with sanitary wastewater, many municipalities and sanitary districts have adopted unrealistic regulations with respect to discharges containing nonfloating fats, oils, and greases (FOG). These regulations need to allow for basic differences between petroleum-based fats, oils, and greases and the edible FOG produced by the food industry. A laboratory program was undertaken to measure various wastewater parameters of selected edible and petroleum oils. The average 5-day biochemical oxygen demand (BOD) to FOG ratio for edible oils was about three times higher than the value for petroleum oils. The average 5-day BOD to chemical oxygen demand ratio for edible oils was significantly higher than the accepted values for biodegradable wastes or for petroleum oils. The average BOD rate constant for edible oils was found to be almost twice the value for typical municipal wastewater and over three times that for petroleum oils. No relationship was found between the chain length or degree of saturation of the edible oil fatty acids and the parameters tested. The edible oils stabilized in a shorter time than did petroleum oils. Short-chain hydrocarbons appear to biologically degrade faster than long-chain hydrocarbons and may be easier to treat biologically. The study results clearly demonstrate that edible oils are considerably more biodegradable than petroleum oils and suggest that there should be no limits for edible oils in wastewater discharges other than a prohibition on oils in floating form. (Carroll-FRC)
W82-06458

TYPE A ZEOLITE IN THE ACTIVATED SLUDGE PROCESSES - I: TREATMENT PARAMETERS,
Imperial Coll. of Science and Technology, London (England).
M. J. T. Carrondo, R. Perry, and J. N. Lester.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2796-2806, November 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Phosphorus removal, *Detergents, *Zeolites, *Activated sludge, *Wastewater treatment, Phosphates, Eutrophication, Nutrient removal, Ammonia, Suspended solids, Chemical oxygen demand, Separation techniques.

Phosphate derived from detergent formulations in which sodium tripolyphosphate (STPP) was used as a builder accounted for about 50% of the phosphorus in domestic wastewater. For this reason, reduction of the level of STPP in detergents was seen as a convenient approach to the control of eutrophication of surface waters. An aluminosilicate, zeolite type A, is being considered as a partial substitute for STPP. Removal of zeolite type A in wastewater treatment is carried out by primary settling and activated sludge processes. The compound reportedly aids in sludge settling and has no adverse effects on the activated sludge process. The effects of zeolite type on various wastewater treatment plant parameters were examined at two activated sludge pilot plants. The chemical oxygen demand and suspended solids in the effluents of the test units were not statistically different from the control units. When levels of ammonia, total phosphate and orthophosphate differed significantly between the test and control units, they were usually lower in the test unit than in the control unit. Sludge volume indices also indicate better settleability of the activated sludge in test units compared to control units. (Geiger-FRC)
W82-06459

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,
Camden County Municipal Utilities Authority, NJ.
C. M. Koch, J. G. Stroka, R. K. Perna, and R. E. Foerster.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 339-343, April, 1982. 2 Fig, 10 Tab, 5 Ref.

Descriptors: *Heavy metals, *Sludge, *Wastewater treatment, *Industrial wastewater, Combined wastewater, Combined treatment, Regulations, Sludge disposal, Land disposal, New Jersey.

The Camden County Municipal Utilities Authority is responsible for wastewater management throughout Camden County, New Jersey. A review of existing wastewater treatment plants showed that many were violating water quality standards. The authority recommended that two upgraded and expanded regional wastewater facilities be constructed to treat all wastewater in the Delaware Basin and that three of the existing four plants in the Atlantic Basin be upgraded. An industrial wastewater survey and sampling program was conducted to develop data for a mass balance for heavy metals, with emphasis on seven key metals considered most likely to limit to land application of sludge or sludge products. This mass balance showed that about 70% of the heavy metal loading observed at the 44 existing wastewater treatment plants was contributed by industrial and domestic sources. Industries were the primary sources of cadmium and chromium. The impact of implementing an industrial pretreatment program was estimated using a typical industrial sewer ordinance. In the absence of industrial pretreatment, cadmium is the heavy metal limiting the sludge application rate. Industrial pretreatment could result in removal of 70% of the cadmium in one service area. However, copper would then become the limiting metal restricting the increase in the allowable sludge land application rate to about 10%. It is concluded that the implementation of industrial pretreatment would have only a minor effect on the permissible land application rate for sludge and on the cost effectiveness of land application as a means of sludge disposal, and then only in some areas. (Carroll-FRC)
W82-06461

DEVELOPMENT OF WASTEWATER PURIFICATION IN THE RUHR CATCHMENT AREA AND ITS EFFECTS ON WATER QUALITY IN THE 1970'S (ENTWICKLUNG DER ABWASSERREINIGUNG IM RUHR EINZUGSGEBIET UND IHRE AUSWIRKUNGEN AUF DIE GEWASSERGUTE IN DEN SIEBZIEGER JAHREN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
R. Klopp, H. Herkelmann, and A. Stozek.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 1-16, January 1982. 19 Fig, 5 Tab, 59 Ref. English summary.

Descriptors: *Wastewater treatment, *Biological oxygen demand, *Biological wastewater treatment, *Ruhr river, *West Germany, Activated sludge process, Filtration, Wastewater facilities, Water treatment facilities, Water quality, Municipal wastewater, Effluents.

The results of monitoring investigations into wastewater plants in the Ruhr area of West Germany for the period 1972-1980 are reported in terms of trends in plant construction and in purification, especially in the parameter five-day BOD (BOD). Although the pollution load of inflow remained the same over the reporting period, BOD levels in plant effluents were reduced (median value 30 mg/1 in 1972, 15 mg/1 in 1980; arithmetic mean 60 and 30 mg/1, respectively). For one-stage activated sludge plants, BOD concentration in effluent was reduced by 50% from 1972 to 1976, after which it remained almost constant at about 10 mg/1. Median BOD was reduced from 30 to 16 mg/1 for one-stage percolating filter plants. For all plants, the degree of BOD purification achieved rose from 73% to 85%; for activated sludge plants from 87% to 93% (this was due to a decrease in mean sludge load to 0.3 BOD/kg day or a median of 0.15 kg BOD/kg day). During the reporting period, 32 plants were constructed or rebuilt. In 1972 there were 112 plants, 76 (68%) of which were biological and 36% (32%) chemical. In 1980 the figures were 120, 101 (84%) and 19 (16%). The new plants achieved a BOD purification rate of 96% (mean 7.3 mg/1 BOD in effluent), though they were built to accommodate increased loads and are not always operating to capacity. BOD effluent loads were reduced by 34%, indicating improved water quality over the reporting period. (Gish-FRC)
W82-06469

BENEFICIAL DISPOSAL OF PICKLE LIQUOR,
Great Lakes Steel, Detroit, MI.
J. N. Howell.
Industrial Wastes, Vol 28, No 3, p 21-22, May/June, 1982. 1 Fig.

Descriptors: *Hydrochloric acid, *Phosphorus removal, *Wastewater treatment, *Chemical precipitation, *Steel industry, *Industrial wastewater, Chemical treatment, Sulfuric acid, Phosphates, Industrial wastes, Wastewater disposal, Waste disposal, Detergents, Domestic wastes.

Cooperation between the city of Detroit and the Great Lakes Division of National Steel of Ecorse, Michigan has eliminated two major pollutants from the Detroit River and Lake Erie. The Detroit Sewage Treatment plant began using pickling liquor generated during the production of strip steel to remove phosphates. Testing showed that pickling done with hydrochloric acid rather than sulfuric acid would be less likely to add sulfate ions to the pickling liquor which would pass through the sewage treatment plant and possibly contribute to the pollution of the lake. By May of 1966, pilot tests were concluded showing that iron in the waste pickling acid was forming an iron phosphate compound which would precipitate, removing up to 65% of the phosphate present in raw sewage. In 1968, storage tanks and pipes were erected to store the waste acid. In 1969, provisions were made for phosphorus removal by ferrous chloride until facilities for pickling wastes could be constructed. Results from 1981 show a 75% savings to the city using pickling liquor for phosphate removal rather

than ferrous chloride. The steel mill saves about $160 thousand per month in hauling and waste contracts for disposal of acid wastes. This operation has been working successfully since 1970. (Geiger-FRC)
W82-06486

EXPANDED WASTEWATER TREATMENT AT A METAL WORKING PLANT,
Gilbert/Commonwealth, Jackson, MI.
S. P. Gambhir, and R. Johnston.
Industrial Wastes, Vol 28, No 3, p 14-16, May/June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Design criteria, *Wastewater facilities, *Industrial wastes, *Metal-finishing wastes, Storm sewers, Oil wastes, Separation techniques, Flocculation, Wastewater management, Waste management, Expansion.

Since its startup in 1975, the Saginaw Steering Gear Division of the General Motors Corporation has consistently met or exceeded state standards in its wastewater treatment plant. Wastewater from the plant originates from the cleanup, spillage and blowdown that occurs during plant operation and from tank truck loading docks and coal pile runoff. An onsite wastewater treatment facility and an auxiliary waste sewer were installed, along with a storm and sanitary sewer. Stormwater flows to retention ponds, where it may be inspected before release to an adjacent wildlife management area. The AW treatment plant began operation in 1976 to handle effluent from two manufacturing plants. During plant expansion, a deep sewer and API separators were installed. Unit processes include free oil removal by gravity and emulsified oil removal by pH adjustment, the breaking of organic polymer emulsions, and flocculation by sodium aluminate. Final effluent is monitored for turbidity, oil content and pH. The new plant was fully integrated into an existing facility while assuring reliability, safety and operational flexibility. (Geiger-FRC)
W82-06487

EXPANDING OPTIONS FOR GREYWATER TREATMENT,
Lombardo and Associates, Boston, MA.
P. Lombardo.
Biocycle, Vol 23, No 3, p 45-49, May/June, 1982. 3 Fig, 15 Ref.

Descriptors: *Water reuse, *Wastewater treatment, *Greywater treatment, *Greywater, Septic tanks, Filters, Sand, Reverse osmosis, Biological wastewater treatment, Sedimentation, Chlorine, Disinfection, Iodine, Ultraviolet radiation, Irradiation, Irrigation, Disposal, Compost toilets.

Greywater is defined as all household wastewater except water used for toilet flushing. The use of compost toilets, fairly well accepted in Scandinavian countries, is gaining acceptance only slowly in the United States. Some provision for managing greywater has to be built into all compost toilet systems. Segregating human wastes and greywater in this manner is atrractive for various reasons. Along with its pollution control qualities, a compost toilet reduces household water consumption by about 40%. Greywater can be used or disposed of in a number of different ways. Treatment and reuse schemes discussed include septic tank, sand filtration, rack filtration, biological treatment units, reverse osmosis, sedimentation/filtration, and physical/chemical treament. Three different disinfectants, tablet chlorine, iodine crystals, and ultraviolet irradiation, are particularly useful for preparing treated greywater for either onsite surface discharge, in-the-house reuse, or outside reuse. Greywater may also be treated and disposed of on soil absorption fields, or through irrigation, greenhouse usage, recirculating showers, or suds-savers. (Baker-FRC)
W82-06491

BACTERIA SOLVE PROBLEMS CREATED BY PRISONERS.
Public Works, Vol 113, No 6, p 57, June, 1982.

Descriptors: *Bacteria, *Organic loading, *Shock loads, Wastewater lagoons, Lagoons, Biological oxygen demand, Sodium nitrate, *Wastewater treatment.

The wastewater lagoon system at the Jean, Nevada, prison was upset by the accumulation of grease in the system (caused by non-maintenance of grease traps) and, in a separate incident several months later, by large amounts of powdered milk and rice dumped into the system during a protest. A high pressure jet cleaned the lines of excess grease. Addition of bacteria concentrate (DBC Plus) and sodium nitrate restored the functioning of a lagoon which was very heavily loaded with organic matter (rice and grease). Since these incidents the bacterial supplement has been added on a maintenance basis at the rate of a quarter pound per day. After prisoners introduced diesel fuel into the waste system, a 1 inch layer of oil accumulated on the surface of both ponds. This problem was solved by burning off small areas over a period of a week. (Cassar-FRC)
W82-06505

LOW-COST TREATMENT OF WASTEWATER,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Public Works, Vol 113, No 6, p 52-54, June, 1982. 5 Fig, 6 Ref.

Descriptors: *Sludge lagoons, *Stabilization ponds, *Aeration, *Wastewater treatment, Lagoons, Ponds, Aerated lagoons.

Mechanically simple alternatives to highly technical, complex wastewater treatment systems include aerated lagoons and benthal stabilization ponds. Although these treatment methods are land intensive, they are often applicable in smaller communities that cannot afford complex plants. Multicellular aerated lagoons can consistently produce effluents with both BOD and total suspended solids levels below 30 mg per liter. Power usege is 68% and construction costs are 40% of those for an activated sludge plant of similar size. A desirable depth is 9-12 ft. Either mechanical aeration or air diffusers may be used. Design of aerated lagoons and retention times can be determined according to equations which consider wastewater characteristics and temperatures. Benthal stabilization of waste activated sludge solids takes place in a deposit at the bottom of a water body by anaerobic or anaerobic/aerobic biological processes. The process is stable and odor free as long as the dissolved oxygen level above the deposit is 2 mg per liter or above. Benthal stabilization systems are over 50% cheaper to construct and over 75% cheaper to operate than an aerobic digester system with sandbed drying. Equations are available to compute the pond area (usual depth 18 ft.) from air temperature, wastewater composition, and solids retention time of the activated sludge process. Sludge solids are removed to a land disposal site about once year, usually during a period of high evapotranspiration. (Cassar-FRC)
W82-06506

CONTROLLING SULFIDES AND ODORS IN SEWERS, PART ONE,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and G. A. Whalen.
Public Works, Vol 113, No 3, p 73-76, March, 1982. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Sulfides, *Aeration, *Odor control, *Wastewater treatment, Hydrogen sulfide, Hydrogen peroxide, Pumping stations, Force mains, Sewer systems, Gloucester County, New Jersey, Compressed air.

The Gloucester County (New Jersey) Utilities Authority installed equipment in three pump stations to control sulfides and odors in sewers by force main aeration and hydrogen peroxide treatment. Aeration at 3-15 cfm produces a wastewater low in color and odor, dissolved oxygen of 0.15 mg per liter or more, less than 0.05 mg per liter unionized hydrogen sulfide, low sulfide concentrations, and increased sulfate concentrations. Equipment for aeration consists of air compressors and associated controls. At the Westville station average flow is 0.37 mgd and the minimum daily flow rate is 15,000 gal per hour in a system with a 46,800 gal volume. Detention time is 3.12 hours. Oxygen use for the 3-hour detention period is 36 mg per liter. The safe design concentration is as great as 125 mg per liter for summer peak loading, assuming 40% efficiency. The unit cost of energy is $6.66 per million gal pumped. At Westville the installed cost of the aeration equipment was $13,500, and annual maintenance costs, $750. Hydrogen peroxide alone did not control odor or suppress sulfide formation. Peroxide use at Westville was reduced By 70% after aeration equipment was installed. (Cassar-FRC)
W82-06509

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,
Metcalf and Eddy. Inc., Boston, MA.
W. A. Peterson, R. W. Corneille, and E. T. Garvey.
Public Works, Vol 113, No 3, p 65-67, March, 1982.

Descriptors: *Data storage and retrieval, *Computers, *Wastewater treatment, *Water treatment, Information systems, Records Operations Data Analysis.

A customized time-shared records and operations data system was designed to help water and wastewater treatment plant personnel in handling operational data. This system, Records and Operations Data Analysis (RODA), is individualized for each facility. Highly flexible software allows programming by each facility without major changes in the base program. Although RODA cannot shorten time required for collection and logging of data, it permits ready access to pertinent data in the desired form so that operators can concentrate on optimizing plant operation. Up to 500 individual parameters may be handled at one plant. A typical plant generated 100-150 parameters, has several pages of monthly report, and 10-12 multiparameter trend plots. Samples of the program's menu and different forms of output (performance reports, trent plots) are given. Costs depend on the size of the plant: $1500-$10,000 yearly operating costs, $3000-$7000 professional assistance, $2,000-$3,000 for a computer terminal, and $7,500-$15,000 for startup, customization, and training. (Cassar-FRC)
W82-06511

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,
Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 3C.
W82-06512

NEW BUBBLE DIFFUSERS REDUCE TREATMENT COSTS,
Wheaton Sanitary District, IL.
R. L. Clavel, and M. A. Scalise.
Public Works, Vol 113, No 6, p 46-47, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Aeration, *Energy, *Costs, *Wastewater treatment, *Bubble diffusers, Dissolved oxygen, Wyss Flex-A-Tube diffusers, Diffusers, *Illinois.

The Wheaton Sanitary District in Illinois has reduced energy consumption by 30-40% in its activated sludge plant by installing fine bubble diffusers in one aeration tank. The Wyss Flex-A-Tube diffuser, made by Water Cleaning, Inc., is a flexible plastic tube covering a non-deteriorating frame molded from acetal polymers. The diffusers resistant to fouling by biological growths and internal clogging. Before installation of the diffusers three blowers were generally used. With the diffusers it was possible to operate the system with only one or two blowers, reducing the average monthly power demand from 300 to 198 KW. (Cassar-FRC)
W82-06513

LIBRARY U. OF I., URBANA-CHAMPAIGN

AN ION EXCHANGE PROCESS TO RECOVER NUTRIENTS FROM SEWAGE,
Istituto di Ricerca Sulle Acque, Bari (Italy).
L. Liberti, and R. Passino.
Resources and Conservation, Vol 6, No 3/4, p 263-273, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Ion exchange, *Nutrient removal, Phosphorus removal, Nitrogen removal, Cation exchange, Anion exchange, Wastewater treatment, Resins, Fertilizers, Magnesium ammonium phosphate.

Selective ion exchange was successfully used to recover nutrients from municipal wastewater effluent. The system, containing clinoptilolite in the cation exchange section and a porous Type I quaternary resin in the anion exchange section, removed eutrophicating materials, filtered suspended matter, and partially adsorbed non-biodegradable organic matter. Ammonia removal was 88% and phosphate removal, 89%. After addition of MgCl2 and MgHPO4 the nutrients were recovered as a commercial, insoluble, slow-release fertilizer, MgNH4PO4 x 6H2O. Column regeneration was accomplished with 0.6 M NaCl. Prior to design of a 240 cu m per day demonstration plant, a three column operation with three cationic and three anionic columns connected in series was also operated in continuous fashion, so that two columns were in service at a time while the third column was being regenerated. (Cassar-FRC)
W82-06516

BIOLOGICAL PROCESSES FOR CONCENTRATING TRACE ELEMENTS FROM URANIUM MINE WATERS,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
C. L. Brierley, and J. A. Brierley.
New Mexico Water Resources Research Institute, Report No 140, December 1981. 93 p, 1 Fig, 26 Tab, 76 Ref, 1 Append.

Descriptors: *Pollutants, *Inorganic compounds, *Mine drainage, *Mine wastes, *Wastewater treatment, *Uranium, *Selenium, *Molybdenum, Ponding, Resins, Tailings, Algal growth, Waste treatment facilities, Filters, Solubility.

New Mexico's uranium and molybdenum mine operations must remove large amounts of inorganic agents from their waters, but current methods are often ion specific and expensive. The objective of this study was to assess the role of biological agents in removal of inorganic trace contaminants from uranium mine wastewaters. The Kerr-McGee Corporation, using two mines, has developed a treatment process for water. Particulates are settled by ponding, and the waters are passed through an ion exchange resin to remove uranium; barium chloride is added to precipitate sulfate and radium from the mine waters. The waters then pass through three consecutive algae ponds prior to discharge. Water sediment and biological samples were collected and analyzed over a 4-year period. Some conclusions derived from these analyses are: the concentrations of soluble uranium, selenium and molybdenum in the waters were not diminished by passage through the treatment facility's impoundments; the mine water's particulate concentrations were reduced about ten-fold by passage through the impoundments; the ponds were well oxygenated; the pH was near normal indicating that the major soluble species of trace contaminants are molybdate, uranyl carbonate species and selenite; plant microbial life can remain viable at 10 degrees C. or higher; conentrations of phosphate and nitrate were high enough to support some algal and microbial activity; the sediments wee anoxic; the algae act as bio-filters for accumulation of particulate pollutants in ponds; and stimulation of algal growth and increased pond size are necessary for effective removal of trace contaminants. (Atkins-Omniplan)
W82-06520

EFFECT OF UV LIGHT DISINFECTION ON ANTIBIOTIC-RESISTANT COLIFORMS IN WASTEWATER EFFLUENTS,
Environmental Protection Agency, Cincinnati, OH.
M. C. Meckes.
Applied and Environmental Microbiology, Vol 43, No 2, p 371-377, Feburary, 1982. 7 Tab, 34 Ref.

Descriptors: *Coliforms, *Ultraviolet radiation, *Activated sludge process, Effluents, *Wastewater treatment, Escherichia coli, Antibiotics, Disinfection, Antibiotic resistance, Resistance factors, Transferable resistance.

Wastewater, both treated and untreated, is a major contributor of bacteria to the aquatic environment. Several studies have shown that significant numbers of multiple drug-resistant coliforms occur in rivers, bays, bathing beaches, and coastal canals. This is a source of considerable concern, since bacteria carrying transmissible R-factors are capable of transferring antibiotic resistance to antibiotic-sensitive bacteria, raising the potential for transfer of antibiotic resistance to pathogenic species. The effect of ultraviolet (UV) light disinfection on antibiotic resistant coliforms in municipal wastewater effluents was investigated. Total coliforms and total coliforms resistant to streptomycin, tetracycline, or chloramphenicol were isolated from filtered activated sludge effluents before and after UV light irradiation. The wastewater effluent was effectively disinfected by the UV irradiation, but the percentage of the total surviving coliform population resistant to tetracycline or chloramphenicol was significantly higher than the percentage of the total coliform population resistant to those antibiotics prior to treatment. UV treatment did not affect the percentages of coliform resistant to streptomycin. Analysis of the multiple drug resistance patterns of 300 total coliform isolates revealed that 82% were resistant to two or more antibiotics. In addition, 46% of these isolates were capable of transferring antibiotic resistance to a sensitive strain of Escherichia coli. (Carroll-FRC)
W82-06532

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,
Technion--Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 5C.
W82-06538

AQUACULTURE FOR WASTE MANAGEMENT,
Nebraska Univ., Lincoln. Dept. of Agronomy.
L. Cchesnin.
Biocycle, Vol 23, No 3, p 52-55, May/June, 1982. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Reviews, *Aquaculture, Wastewater management, Wastewater disposal, Water resources development, Fish farming, Fish, Nutrients, Sludge disposal, Aeration, Lagoons, Ponds, Microbial degradation, Biodegradation.

The current status of aquaculture research in the area of waste resource utilization indicates that a significant though largely untapped potential exists for the production of aquatic protein for human and animal consumption. Findings from various studies investigating the utilization of animal wastes have indicated that fish production was 1.8 times greater when manure was introduced directly into the environment as compared to supply only manure-grown algae as a feed source, that fish had a beneficial effect on water quality in ponds receiving wastes from two lots of pigs insofar as dissolved oxygen and BOD were concerned, that fish grew well in ponds receiving wastes from pig pens, that greater productions of Chinese carp and freshwater prawns were obtained in a polyculture system when the ponds were supplied fresh swine manure than when supplied with aged swine manure, and that inputs of manure and commercial feed has similar protein yield relationships in hybrid tilapia production. The incresed use of human wastes and sewage for fish production depends mainly on public acceptance. Studies have shown that human to fish ponds have resulted in higher yields than in ponds supplied with commercial fish feeds. Sewage treatment ponds stocked with fish had higher dissolved oxygen concentrations and pH than similar ponds without fish. Industrial wastes, such as distillers' wet grains, were successfully fed to fish and crayfish as the only source of food. With sufficient aeration and retention time for microbial decomposition it would appear that high biological oxygen demand organic wastes could be used to provide the substrate for a polyculture aqatic system. (Baker-FRC)
W82-06556

FRENCH PREMIERE FOR WASTEWATER DISINFECTION USING OZONE.
World Water, Vol 5, No 5, p 43-44, May, 1982.

Descriptors: *Ozone, *Disinfection, *Wastewater oxidation, *Wastewater treatment, Tertiary wastewater treatment, Guethary, *France.

The first French wastewater treatment plant to use ozone for final disinfection is Guethary, a resort town on the Atlantic Ocean. The plant handles a population equivalent of 1250 in winter and 13,000 in summer. Since effluent is discharged into the ocean in the bathing area, it is necessary to remove biological pollution completely. The treatment process is activated sludge with prior clarification-flocculation during the tourist season. Tertiary treatment is provided by a rapid gravity sand filter. The ozone dose is 10 g per cu meter of effluent treated. (Cassar-FRC)
W82-06607

METAL REMOVAL 'A LA CARTE',
For primary bibliographic entry see Field 5F.
W82-06608

THE ROLE OF ELEMENTAL OXYGEN DEMAND IN TOTAL OXYGEN DEMAND FOR WATER POLLUTANTS,
Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima, T. Ishizuka, and H. Sunahara.
Water Research, Vol 16, No 6, p 1003-1009, June, 1982. 1 Fig, 7 Tab, 5 Ref.

Descriptors: *Oxygen demand, *Water quality, Industrial wastewater, Nitrogen, Oxygen, Water pollution control, Biochemical oxygen demand, Wastewater treatment.

The fundamental relationship between total oxygen demand (TOD) and elemental oxygen demand (EOD) for various organic and inorganic compounds in water was studied using a total organic carbon (TOC)-TOD analyzer and a TN (total nitrogen) analyzer on the influent and effluent in an activated sludge pilot plant. The EOD values of carbon and nitrogen in the constituent units of water pollutants were measured, and the relative TOD levels were discussed. The COD/TOD and NOD/TOD ratios of several organic compounds, proteins, and microbes in activated sludge were above 0.6 and below 0.25, respectively. However, in the effluent of a pilot plant the NOD/TOD value was larger than the COD/TOD value, indicating the NOD plays a more important role in the TOD value than in the COD value. The concept of EOD can also be used to characterize the TOD of pollutants in environmental waters such as river water, lake water and other water bodies. (Baker-FRC)
W82-06611

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),
For primary bibliographic entry see Field 8C.
W82-06633

INVESTIGATIONS ON LOADING AND QUALITY OF DISCHARGE OF MUNICIPAL SEWAGE TREATMENT PLANTS IN THE CASE OF STORMWATER INFLOW (UTERSUCHUNGEN UBER BELASTUNG UND ABLAUFBESCHAFFENHEIT KOMMUNALER

KLARANLAGEN BEI MISCHWASSERZUFLUSS),
Bayerisches Landesamt fuer Wasserwirtschaft, Muinich (Germany, F.R.),
P. Schleypen, and P. Wolf.
Wasserwirtschaft, Vol 72, No 2, p 53-59, February, 1982. 7 Fig, 5 Tab, 5 Ref. English summary.

Descriptors: *Municipal wastewater, *Storm wastewater, *Suspended solids, *Biological oxygen demand, *Chemical oxygen demand, Activated sludge process, *Wastewater treatment, Pollutants, Percolating filters, Wastewater lagoons, Biological wastewater treatment, Water law, *West Germany, Design standards, Hydraulic engineering.

Inflow, BOD, COD, and suspended solids were examined at 21 West German municipal biological wastewater treatment plants in dry and rainy weather to determine whether the plants could handle the increased demands made by stormwater. The facilities comprised two two-stage biological plants, one nonaerated sewage pond, three percolating filter plants, and six activated sludge plants with and six without presettling. Results showed that in rainy weather an increase in plant discharge of five-day BOD and COD with respect to dry weather must be expected. This increase is insignificant when measured over 24 hours, but over a 2-hour period a mean increase of 30% for five-day BOD may occur. Stormwater created an increased hydraulic demand on the plants, leading to an increase in the pollution load of their discharge of 2.5-3 times of that in dry weather when hydraulic load was increased twofold. For the mean values measured, percolating filter and activated sludge plants performed similarly, but percolating filter plants performed less well for maximum values due to operating problems in the control of filter loading and postsettling-basin size. Activated sludge plants with low capacity loading are capable of handling stormwater because of their large buffer volume. Sewage ponds of adequate dimensions behave in a similar fashion to activated sludge plants with low loads. With the exception of sewage ponds, suspended solids concentration in the discharge of municipal plants can increase greatly in rainy weather even where postsettling conforms to standard. A change in water law is therefore necessary, and this should double the permissible level of suspended solids in discharge when stormwater is being processed. This is prudent for technical, operational, and economic reasons. (Gish-FRC)
W82-06634

HOW MUCH AIR,
Montgomery (James M) Inc., Pasadena, CA.
M. L. Arora.
Water/Engineering and Management, Vol 129, No 7, p 43-44, 47, June, 1982. 2 Fig, 5 Tab.

Descriptors: *Aeration, *Activated sludge proces, *Oxygen transfer, Design criteria, Temperature effects, Altitude, *Wastewater treatment, Oxygenation, Dissolved oxygen.

Several approaches are available for calculating the air requirements and aeration system horsepower for activated sludge systems. First the theoretical field condition requirements are computed. Then these are converted to standard conditions (20 C liquid temperature, zero mg per liter dissolved oxygen in the aeration basin, sea level, and tap water). The effects of several parameters on aeration equipment performance are discussed. Alpha, the relative rate of oxygen transfer in wastewater as compared to tap water, is a function of the type of waste and the type of aeration equipment. It varies from 0.4 to 1.0. Higher values of alpha reduce the required horsepower. Surfactants and fine bubble diffusers tend to lower alpha values. Beta, the relative oxygen saturation value in wastewater as compared to clean water under standard conditions of temperature and altitude, is strictly a function of the type of waste. Higher values are beneficial. For normal domestic sewage the range of beta values is 0.8 to 0.95. Oxygen concentration is often overdesigned. A 2.0 mg per liter concentration during normal operation or 1.0 mg per liter during short-term peak loads is satisfactory. Higher air and wastewater temperatures can significantly decrease oxygen saturation concentrations. This condition, as well as the higher oxygen uptake ratios at higher temperatures, must be considered in designing equipment. Altitude effects are similar to temperature effects. For example, a plant at 7000 ft altitude may require 877 horsepower vs 610 horsepower for a sea level plant for 1000 lb per hour aeration equipment, providing other conditions are the same. (Cassar-FRC)
W82-06638

PAC PROCESS,
Zimpro, Inc., Rothschild, WI.
J. A. Meidl.
Water/Engineering and Management, Vol 129, No 7, p 33-36, June, 1982. 4 Fig, 4 Tab.

Descriptors: *Activated carbon, *Activated sludge process, *Wastewater treatment, *Powdered activated carbon, Zimpro, Incorporated, Costs, Organic compounds, Priority pollutants, Sludge, Nitrogen removal, Oxygen transfer, Disinfection, Odor control.

Patents on use of powdered activated carbon (PAC) in the aeration tank of the activated sludge system were developed by DuPont and purchased by Zimpro, Inc. Since 1977 the system has been used for treating a diverse range of wastewaters in plants of 500 kl to 54 mgd capacity. The wet air regeneration process recovers 95% of the carbon with no dewatering or added heat. There are several advantages to the PAC process: improved organics (including priority pollutants) and nitrogen removal; and reduced sludge volume index, power requirements (up to 20%), disinfection requirements, and sludge quantity. In addition, odor control costs are minimized. The process' status as an innovative technology allows 10% extra EPA funds. The process using wet air regeneration is cost competitive with conventional activated sludge treatment and granular activated carbon treatment. Design guidelines and experiences at operating plants are discussed. (Cassar-FRC)
W82-06643

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,
Northumbrian Water Authority (England).
For primary bibliographic entry see Field 5E.
W82-06645

MICROSTRAINER THEORY AND THE FILTRABILITY INDEX OF SEWAGE EFFLUENTS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
J. A. Anderson.
Water Pollution Control, Vol 81, No 1, p 120-126, 1982. 7 Fig, 9 Ref.

Descriptors: *Filtration, *Secondary wastewater, *Suspended solids, *Wastewater treatment, Solids contact processes, Mathematical equations, Process efficiency.

Microstraining refers to the mechanical separation of solids from liquids resulting from the passage of a secondary effluent through a porous fabric having apertures of less than 100 microns. The filtrability of a fluid is a function of the fluid, the suspended solids, and the filter medium. Boucher (1947) introduced the term 'filtrability index', which relates the head loss across the microstrainer to the flow rate. The error inherent in this previously accepted equation is demonstrated through a discussion of the theory of microstrainers. A simple piece of equipment, marketed under the name Filtester, can be used to measure the filtrability index. This equipment produces a filtrate almost identical to that obtained from an operating microstrainer, which can be analyzed for suspended solids and biochemical oxygen demand removal efficiences. Effluents from biological filters, humus tanks, and rapid gravity sand filters were used to investigate measurement of the filtrability index. The results of these tests demonstrated a strong correlation between the filtrability index and the concentration of suspended solids removed by the microstrainer. The correlation between the suspended solids removal efficiency and the ratio of filtrability index to the suspended solids concentration in the effluent was not as strong. The Filtester was found to provide a simple and inexpensive means for assessing the performance of a proposed microstrainer installation with respect to any given effluent. Microstrainers can be used effectively for tertiary treatment only if the suspended solids in the secondary effluent are present in the form of easily filterable floc particles. Factors which may affect the removal of suspended solids include particle size, particle shape and structure, shear resistance, and compressibility. (Carroll-FRC)
W82-06647

PILOT-SCALE ADVANCED WASTE-WATER TREATMENT AT DAVYHULME,
North West Water Authority (England).
T. E. Wallbank, and T. A. Parry.
Water Pollution Control, Vol 81, No 1, p 127-141, 1982. 9 Fig, 9 Tab, 22 Ref.

Descriptors: *Pilot plants, *Advanced wastewater treatment, Experimental design, *Wastewater facilities, Physicochemcial treatment, Biological treatment, Cost analysis, Process efficiency, Effluents, *United Kingdom, Davyhulme.

An advanced wastewater treatment pilot plant was constructed at the Davyhulme works in the United Kingdom to evaluate the use of physicochemical and biological processes in various combinations, to investigate the potential for production of effluents suitable for industrial reuse, and to determine the cost benefits of these processes. The principal experiments conducted during the 5-year study are summarized. Flocculation of crude sewage with lime was found to significantly increase the removal of suspended solids in primary sedimentation, reducing the biochemical oxygen demand loading on the subsequent biological stage. Settled sewage having a pH value as high as 11.5 could be treated successfully by the activated sludge process. Primary lime dosing to pH 10 removed about 80% of the suspended solids, while using lime to pH 9 plus aluminum sulfate achieved slightly better results at marginally higher costs. Tertiary treatment by dual-media filtration and granular activated carbon resulted in production of high quality effluents, perhaps suitable for industrial reuse. Primary lime treatment appeared to slightly enhance the activity of nitrifying microorganisms in two completely-mixed activated-sludge units. Considerable variations were found in the conditioner types and dose rates required for mechanical dewatering of the chemical and biological sludges produced by the plant. The performance predictions developed by using data from the plant in the sewage treatment optimization model were found to be accurate over a wide range of flows. (Carroll-FRC)
W82-06649

PERFORMANCE OF ROTATING BIOLOGICAL CONTACTORS UNDER FIELD CONDITIONS,
Water Research Centre, Stevenage (England).
E. B. Pike, C. H. Carlton-Smith, R. H. Evans, and D. W. Harrington.
Water Pollution Control, Vol 81, No 1, p 10-27, 1982. 4 Fig, 7 Tab, 54 Ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, Industrial wastewater, *Performance evaluation, Wastewater composition, Wastewater oxidation, On-site studies, *Rotating biological contactors.

Factors affecting the performance of commercial rotating biological contactor units installed at wastewater treatment facilities were investigated Specific factors found to adversely affect performance at units in facilities serving small communities included organic overloading and mixing of liquors between treatment units. Performance was best at the two facilities which had two and three stages of disks in series and which had separate primary treatment and humus settlement units, suggesting that characteristics tending to plug-flow were de-

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sirable in the disk compartment. The sets of data for composition of sewage and effluents were distributed approximately log-normally, and, for sets of samples taken throughout treatment, the variance of biological oxygen demand and suspended solids was related to the arithmetic mean by a power law. If this relationship is general, it could be used to calculate percentile values for any given mean value of effluent quality for use in performance modeling. A two-year study of a 30-population-equivalent unit found that on the average performance and rates of treatment were greater, and sludge production was lower in the year when flow varied over a diurnal cycle than in the year of operation with steady flow at a uniform average rate. The results of analysis of variance tests suggested that attempts to reduce variability in effluent quality on a daily basis should not be undertaken without a critical assessment of the temporal components of variability at the facility. (Carroll-FRC)
W82-06650

ESHOLT--PAST, PRESENT AND FUTURE,
Yorkshire Water Authority (England). Western Div.
J. O'Neill.
Water Pollution Control, Vol 81, No 1, p 28-36, 1982. 4 Fig.

Descriptors: *Wastewater treatment, *Industrial wastewater, History, Wool scouring, *Textile mill wastes, *Dye industry wastes, Wastewater facilities, Municipal wastewater, Combined wastewater, Combined treatment, Bradford, *United Kingdom.

The city of Bradford, England has been a center of the textile and wool-combing industry since the early part of the 19th century. The city constructed sewers in 1862, which removed the wastes from the town's environs but resulted in serious pollution of the River Aire. The first waste treatment facilities were established in 1872. Waste treatment facilities constructed by the city in 1912 included a sludge presshouse for the treatment of sludge from chemical precipitation of combined wastewater with sulfuric acid. Over the next 50 years, the Esholt wastewater treatment facility was expanded to include precipitation tanks, biological filters, detritus and storm-sewage tanks, humus tanks, a clarification lake, and grease recovery facilities. In 1973, a multiple-hearth sludge incinerator was added. Changes in the wool industry have resulted in a 90% decrease in the amount of grease recovered at Esholt. However, the sewage treated, which gets about 60% of its organic load from industry, remained strong. A complete re-evaluation of the treatment facility in 1977 resulted in a decision to discontinue sludge processing and dewatering operations and to replace these with sludge consolidation followed by disposal of liquid sludge either to the land or to the sea. This change in operations resulted in a significant improvement in effluent quality, primarily as the result of improved settlement and the change of the bacteriological environment of the filter beds from acidic to nonacidic. (Carroll-FRC)
W82-06653

RECOVERY OF PROTEIN AND OIL FROM FISHERY BLOODWATER WASTE, EFFECT OF PH AND TEMPERATURE,
Instituto Nacional de Technologia Industrial, Mar del Plata (Argentina).
E. M. Civit, M. A. Parin, and H. M. Lupin.
Water Research, Vol 16, No 6, p 809-814, June, 1982. 7 Fig, 2 Tab, 39 Ref.

Descriptors: Fisheries, *Wastewater treatment, *Industrial wastewater, *Proteins, *Oils, Acidity, *Temperature effects, *Hydrogen ion concentration, Heat treatment, Coagulation.

The study investigated the conditions of temperature and optimum pH for protein coagulation and oil recovery from fisheries bloodwater. Information about the variation of the chemical oxygen demand (COD) of the effluent and about the kind of proteinaceous material recovered and remaining in solution was also obtained. Heating must be carried out above 65 degrees C, but temperatures above 75-80 degrees C will not improve recovery. The optimum range for the adjustment of pH was between 5.6-5.9. The maximum reduction in COD was found in the same temperature and pH ranges. The combination of heating and pH adjustment was shown to be more effective than each process by itself. Delay in processing increased the non protein nitrogen and diminished the protein recovery and the COD reduction. (Baker-FRC)
W82-06655

CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF SEWAGE EFFLUENTS. IS LONG TERM PERFORMANCE A LIMITING FACTOR,
Portsmouth Polytechnic (England). Dept. of Civil Engineering.
B. A. Winfield.
Water Research, Vol 16, No 6, p 797-799, June, 1982. 2 Fig, 7 Ref.

Descriptors: *Reverse osmosis, *Membranes, *Membrane processes, Membrane filters, *Wastewater treatment, *Cellulose acetate membranes.

The performance of cellulose acetate reverse osmosis membranes was examined in the treatment of secondary sewage effluents over a three year period. A commercially available 'spaghetti' type unit was used for the study. This unit was fed with pH adjusted (5.5-6.0) secondary sewage effluent during normal operation. It was flushed monthly with a 0.5% formaldehyde solution. The exposure of the membranes to sewage treatment conditions produced changes in their performance which differed markedly from anything which had been anticipated. The observed increase in permeability for the sulfate ion was 1.5 times and for the sodium ion 1.2 times. Observed trends in water permeability also deviated from the predicted behavior. Hydrolysis should result in an increase in water flow per unit area, while in fact the reverse occurred. Thus any loss of permselectivity is likely to be minimized by the deposition of fouling over porous regions of the membrane created by hydrolysis and also microbiological activity. Another effect of the deposition of fouling over imperfect regions of the membrane is that it effectively contributes to a loss of the active membrane surface. (Baker-FRC)
W82-06657

RECOVERY OF CHROMIUM(VI) FROM WASTEWATERS WITH IRON(III) HYDROXIDE-I. ADSORPTION MECHANISM OF CHROMIUM(VI) ON IRON(III) HYDROXIDE,
Osaka Prefecture Univ. (Japan). Coll. of Engineering.
T. Aoki, and M. Munemori.
Water Research, Vol 16, No 6, p 793-796, June, 1982. 7 Fig, 12 Ref.

Descriptors: *Wastewater treatment, *Chemical reactions, *Chromium, *Iron, Hydroxide, Adsorption, Metals, Ion exchange, Anion exchange, *Hydroxides.

The mechanism of chromium(VI) adsorption on iron(III) hydroxide was investigated. As pH decreased, the coprecipitation of Cr(VI) with iron(III) hydroxide increased; no coprecipitation occurred above a pH of 8.5. An increase in the coprecipitation also occurred with an increase in the amount of iron(III) hydroxide. When the suspension (pH 4.5) containing ironIII hydroxide was mixed with a solution (pH 4.5) containing Cr(VI), the pH of the mixed suspension increased and became constant after 20-30 minutes. When the suspension of pH 4.5 stood for a month, its pH decreased from 4.5 to 3.8, and a small percent of Cr(VI) was desorbed from the iron(III) hydroxide. The decrease of pH was not due to carbon dioxide from the air. Thus it is assumed that the oxolation of iron(III) hydroxide caused a decrease in pH over time. To formulate the forces governing the exchange between adsorbed HCr04(-) and other anions, desorption of Cr(VI) was examined in the presence of various anions. Desorption of HCr04(-) increased with increase of the added anion. It appeared that the main factor governing adsorption of the anions is ion bonding and a specific chemical bonding with the surface of the iron(III) hydroxide. The adsorption of Cr(VI) was increased in the presence of metal ions because the positive charge due to adsorption of metal ions on iron(III) hydroxide increased and attracted HCr04(-) to the surface of iron(III) hydroxide and because the metal hydroxides partially formed below pH 8.5 and increased anion exchangeable sites. (Baker-FRC)
W82-06658

THE KINETICS OF OZONE-PHENOL REACTION IN AQUEOUS SOLUTIONS,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
M. G. Joshi, and R. L. Shambaugh.
Water Research, Vol 16, No 6, p 933-938, June, 1982. 3 Fig, 4 Tab, 30 Ref.

Descriptors: *Ozonation, *Kinetics, Chemical reactions, *Phenols, Water pollution, *Ozone, *Wastewater treatment, Laboratory studies, Oxidation, Chlorination, Industrial wastewater, Coal gasification.

Rate constants were determined for the reaction of ozone and phenol in water. Careful account was made of the mass transfer of ozone from gas phase to aqueous phase, and the effect of pH and various soluble salts on the rate constant for phenol ozonation was studied. Rate constants were determined for the solid catalyzed reaction of ozone and phenol in water using four different catalysts. Initially a few experiments were carried out to check for mass transfer limitations. In these experiments only the flow rate of ozone-oxygen mixture fed to the reactor was varied, keeping everything else the same. The results indicated that mass transfer resistance was not likely to be a limiting factor. The effects of the pH of the reaction mixture, the solid catalysts, and the presence of certain solutes in the reaction mixture on the reaction kinetics were also investigated. The study concluded that the reaction of ozone with phenol in aqueous solution can be adequately represented by a second order rate equation and does not involve hydroxide ion radicals. The catalysts which are effective in the oxidation of aqueous phenol by molecular oxygen are not effective in enhancing the rate of ozonation of aqueous phenol. Hence, the mechanism of ozonation is quite different from that of oxidation with simple oxygen. (Baker-FRC)
W82-06661

INFLUENCE OF MULTICELLULAR CONFIGURATIONS ON ALGAL GROWTH IN AERATED LAGOONS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 6, p 929-931, June, 1982. 3 Fig, 7 Ref.

Descriptors: *Aerated lagoons, *Algal growth, Aeration, Lagoons, Anaerobic lagoons, Eutrophication, *Wastewater treatment, *Municipal wastewater.

The combined influence of the multicellular configuration and retention time on algal growth in aerated lagoons is considered. In lagoons treating domestic wastewaters, growth is controlled by light and carbon dioxide. Beyond the first cell in a dual-power level system, light penetration is relatively uniform from cell to cell due to the low and equal levels of aeration employed in that part of the lagoon system. The carbon dioxide concentration will also be relatively uniform from cell to cell. In an experiment aimed at calculating the annual mean concentrations of suspended solids in the effluents of two polishing pond systems receiving a secondary effluent from a domestic wastewater treatment plant, one system consisted of a single cell and the other of four cells in series. At retention times less than 2 days, the effluent suspended solids from both systems decreased as a result of sedimentation of suspended solids in the secondary effluent; the subsequent increase reflected the generation of algae in the pond systems. The increase in effluent suspended solids occurred at a

much greater rate in the single cell system than in the four cell system. The difference in performance can be explained in terms of the hydraulics of an ideal system. Only 6.2% of the effluent from the three cell system has a retention time greater than twice the average retention time, as compared with 13.5% for the single-cell system. For a four-cell system, the percentage drops to 4.2. This reduction in the percent of effluent with long retention times is responsible for the suppressive effect on growth which was noted. (Baker-FRC)
W82-06662

DERIVATION OF AN EMPIRICAL SORPTION RATE EQUATION BY ANALYSIS OF EXPERIMENTAL DATA,
Colorado State Univ., Fort Collins. Dept of Civil Engineering.
D. W. Hendricks, and L. G. Kuratti.
Water Research, Vol 16, No 6, p 829-837, June, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Sorption, *Mathematical equations, Regression analysis, Kinetics, Model studies, Mathematical models, Continuous flow, Filters, Packed beds, Reactors, *Wastewater treatment.

In this work five postulated sorption rate equations are tested in terms of their fits to experimental data. The data were generated by sorption uptake tests in batch reactors. The range of experimental conditions included two sorbate-sorbent combinations, four temperatures, and 30 initial concentrations of sorbate, giving a total of 240 tests. A sorption uptake curve was plotted for each experimental test; the rate coefficients for the five rate equations were determined by the differential method from the uptake curves. The fits of the different rate coefficients plotted against solution concentrations were evaluated by visual indication of scatter and by regression analysis. Through this screening process the validity of one of the equations was ascertained. Uptake rate was dependent on degree of sorbent saturation with sorbate and liquid phase sorbate concentration. The rate equation verified above was documented over a wide range of experimental conditions. The equation is a basis for routine lab tests of sorption uptake with time. The coefficients for the particular system of interest can be obtained from these tests. Further work is needed to ascertain the validity of the equation over a broad range of hydrodynamic conditions. The larger goal is to ascertain an easy to use kinetic model which has application in reactor design. (Baker-FRC)
W82-06664

DYNAMICS OF BIOFILM PROCESSES: METHODS,
Montana State Univ., Bozeman. Coll. of Engineering.
W. G. Characklis, M. G. Trulear, J. D. Bryers, and N. Zelver.
Water Research, Vol 16, No 7, p 1207-1216, July, 1982. 10 Fig, 5 Tab, 40 Ref.

Descriptors: *Biofilms, *Bacteria, Measuring instruments, *Wastewater treatment, Laboratory studies, On-site studies.

This paper reviews methods for measuring biofilm development processes in the laboratory and in the field. Two reactor geometries were used to study biofilm development and destruction. The circular type was used, as it is the prevalent geometry in heat exchangers. The rotating annular reactor was also tested because of its compactness and ease of operation. Direct measurement of biofilm quantity is essential in calibration of indirect measurement techniques for determining biofilm quantity, in the use of mass conversion equations for determining process rates and stoichiometry, and in relating biofilm development to fluid frictional resistance and heat transfer resistance in a rational manner. Indirect measurement of biofilm quantity using a specific biofilm constituent has certain advantages, including the facts that some of the indirect methods are more sensitive, and that indirect measures provide information regarding biofilm composition and hence stoichiometry of biofilm processes. Indirect measurement of biofilm quantity through microbial activity within the biofilm is useful in certain instances, such as in determining the physiological state of the organisms in the biofilm, in some measurements of biofilm activity which are extremely sensitive, and in substrate removal rates which are needed when employing mass conservation equations. The choice of analytical method for monitoring biofilm processes will be dependent on the questions which prompt the investigation. (Baker-FRC)
W82-06666

THE BEHAVIOUR OF NITRILOTRIACETIC ACID DURING THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
Imperial Coll. of Science and Technology. London (England). Public Health Engineering Lab.
P. W. W. Kirk, J. N. Lester, and R. Perry.
Water Research, Vol 16, No 6, p 973-980, June, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Anaerobic digestion, *Nitrilotriacetic acid, Chelating agents, Sludge digestion, Sludge, Digestion, Biodegradation, Anaerobic conditions, Activated sludge process, *Wastewater treatment, Land disposal, Sludge disposal.

The fate of nitrilotriacetic acid (NTA) in anaerobic digesters fed with mixed primary sludge was investigated. Each of four digesters was initially seeded with 1 liter fresh digested sludge and 0.5 liters of mixed primary sludge. Subsequent additions consisted of mixed primary only, diluted with distilled water. Two sequential additions of 1.5 g calcium hydroxide were made to each digester on days 6 and 8. From days 12-24 prolonged purging of the digester was undertaken with oxygen-free nitrogen following each addition of influent sludge. After stabilization periods of 50 days, NTA was spiked into three digesters to produce concentrations of 10, 20 and 30 mg/liter in the digesting sludge. All subsequent feeds to these three digesters contained NTA concentrations of 10, 20 or 30 mg/liter respectively. The percentage removal of NTA from solution during anaerobic digestion decreased with increasing influent concentration. Addition of sodium azide, which prevented anaerobic degradation of the volatile solids, did not increase soluble NTA concentrations in the digesters, indicating that the removal observed was not the result of biodegradation. It was apparent that the current widespread application of anaerobic digestion in sewage treatment would result in a large percentage of any NTA present passing through this treatment unaffected, with unknown consequences for the application of this sludge to agricultural land. (Baker-FRC)
W82-06667

APPARATUS FOR CLEANING WATER CONTAINING FOREIGN PARTICLES SUCH AS SUSPENDED MATTERS OR OIL,
H. Ino, and R. Ino.
U.S. Patent No 4,203,849, 7 p, 14 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 989-990, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Oil pollution, Suspended solids, Equipment.

The object of this invention is to provide an apparatus for cleaning water which is characterized by a number of inclined partition plates that are placed in a container at regular intervals in such a way that the plates are slanted with respect to the horizontal and vertical planes. The basic principal lies in the fact that the separation chamber is separated by partition plates into a number of oblique passages which make the settling distance (that is the distance the particles travel before settling on the plates) of the suspended particle short and which also changes the direction of movement of the suspended particles relative to the direction of the water so that the suspended particles are completely separated from the water. (Sinha-OEIS)
W82-06699

FERRATE ION: POTENTIAL USES IN ADVANCED WASTEWATER TREATMENT,
Nebraska Univ., Lincoln. Dept. of Chemistry.
J. D. Carr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256751, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Report, June, 1982, Lincoln, Nebr. 39 p, 5 Fig, 5 Tab, 10 Ref. OWRT A-053-NEB(3), 14-34-0001-9029.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Iron, *Oxidation, *Kinetics, *Organic compounds, Wastewater, Organic wastes, Wastes, Organic matter, Organic loading, Oxidized wastewater, Oxidation process, Wastewater oxidation, Chemical oxygen demand, Spectrophotometry, Spectral analysis, Iron compounds, Chemical analysis, Water analysis.

The potential use of ferrate (VI) ion in the treatment of industrial wastewater containing particularly objectionable organic compounds in the absence of a high biochemical oxygen demand was explored. The oxidation kinetics of a variety of aqueous organic solutes by ferrate (VI) ion and the identification of potential reaction products were carried out. Kinetic measurements were made by visible spectrophotometry at conventional and stopped-flow speeds. The oxidation of water by ferrate (VI) occurs by two parallel pathways; one being first-order in ferrate (VI); the other being second-order. The former (and its pH dependence) was interpreted in terms of the rapid decomposition of H2Fe04; the latter, in terms of the rapid decomposition of Fe207 divalent anion. Both species are transient intermediates which are directly unobservable due to their short lifetimes. A new method for interpreting mixed-order kinetics was developed. Iron (II) was unexpectedly observed as an intermediate in the reduction of iron (VI) to iron (III). The overall conclusion of these studies was that there are many situations where ferrate (VI) can be used to advantage in wastewater decontamination, especially in industrial situations in which specific objectionable organics are produced in the presence of a low biochemical oxygen demand. The oxidation kinetics of nitrilotriacetic acid, aliphatic alcohols, ammonia and alkylamines, ethylene glycol, cyanide, phenol, and diethyl-sulfide are reported. (Zielinski-MAXIMA)
W82-06701

PILOT PLANT STUDIES OF COPPER, ZINC, AND TRIVALENT CHROMIUM REMOVAL BY ADSORBING COLLOID FOAM FLOTATION,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256827, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 88, August, 1981, Knoxville. 74 p, 7 Fig, 20 Tab, 31 Ref. OWRT A-064-TENN(1), 14-34-0001-1145.

Descriptors: *Industrial wastewater, *Metal-finishing wastes, *Copper, *Zinc, *Chromium, *Wastewater treatment, Wastewater, Heavy metals, Industrial wastes, Colloids, Gels, Flotation, Foam separation, Hydraulic loading, Trace metals, Coagulation, Chemical coagulation, Water treatment, Adsorbents, Adsorption.

Design parameters were considered for adsorbing colloid foam flotation (ACFF) for treating metal finishing industry wastewaters. Combinations of copper, zinc, and chromium (III) were studied, as well as the effects of pH, hydraulic loading rate, coagulant and surfactant doses, ionic strength, and air flowrate on metal removal. These data led to the development of mathematical expressions relating coagulant dose with metal removal. The study results indicated that ACFF is a feasible method for treating heavy metal-bearing wastewaters. Coagulant doses of about 100 mg/liter lowered metal concentrations from 20 mg/liter at optimum pH (7.0-7.6) and low ionic strength (below 0.05), to

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0.1-0.5 mg/liter. Hydraulic loadings up to 15 cu m per sq m per hour. Economic analysis of the ACFF process indicated it to be less expensive than alkaline precipitation. The ACFF process found to be simple and rapid, requiring low space and energy for operation, and yielding small concentrated sludge volumes. The low residual metal levels consistently achieved were below currently mandated regulatory effluent standards, as well as the 1984 BAT-equivalent guidelines. (Zielinski-MAXIMA)
W82-06708

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W82-06709

INVESTIGATIONS INTO THE NITRIFICATION OF SYDNEY'S WASTEWATERS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
P. J. Bliss, D. Barnes, and B. A. Windshuttel.
Effluent and Water Treatment Journal, Vol 22, No 4, p 137-140, 142-143, 145, April, 1982, 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Nitrification, *Design criteria, *Activated sludge process, *Wastewater treatment, Sydney, *Australia, Retention time, Dissolved oxygen, Oxygen, Ammonium, Seasonal variation, Aeration.

Design requirements for nitrification in the activated sludge process were studied in full-scale runs at the Castle Hill treatment plant in Sydney, Australia. Mean cell residence time requirements to initiate nitrification were 20 days for winter (13-14 C) and 4 days in summer under optimum conditions: dissolved oxygen of 4-5 mg per liter and flow equalization (peak-to-average ammonium ratios less than 1.7). These conditions produced an effluent with ammonium concentrations of 2 mg per liter average and 5 mg per liter peak. Higher effluent ammonium concentrations resulted under transient loads or at lower dissolved oxygen levels. At high mixed liquor suspended solids concentrations, solids were lost in the clarifier effluent. A pH range of 6.5-8.0 was suitable for nitrification. For a optimal design of nitrifying activated sludge plants the system components must be balanced. For example, the design mean cell residence time and aeration tank volume are minimal at higher (4-5 mg per liter) dissolved oxygen concentrations and with flow equalization. However, the higher dissolved oxygen requires a larger aeration system, and flow equalization requires larger storage capacity. At higher mixed liquor suspended solids concentrations the aeration tank volume may be reduced, but the clarifier capacity must be increased. There is also evidence that sludge settleability is reduced at high dissolved oxygen concentrations. (Cassar-FRC)
W82-06724

PUT PRESSURE ON SEWAGE,
Greenhorne and O'Mara, Inc., Riverdale, MD.
L. N. Rydland.
American City and County, Vol 97, No 6, p 47-48, June, 1982.

Descriptors: *Sewar systems, *Wastewater collection, *Septic tanks, *Wastewater treatment, Pumps, Rural areas, Grinder pumps, Pressure sewer systems.

Pressure sewer systems are available to convey sewage from rural homes with faulty on-site disposal systems to establish sewer networks. The septic tank effluent pump (STEP) system consists of a receiving tank, a pump, control sensors, piping, and valves. The grinder pump (GP) system has a grinder, pump, check valve, automated controls, holding tank, and venting system. In the STEP system the existing septic tank must be intact and working properly; otherwise it is removed or bypassed. The GP system involves a totally new on-lot installation. It eliminates reliance on septic tanks, requires less property disruption and piping, and pumps aerobic, rather than anaerobic, sewage to the treatment plant. (Cassar-FRC)
W82-06732

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,
Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
For primary bibliographic entry see Field 5A.
W82-06734

EVIDENCE THAT MICROORGANISMS CAUSE INACTIVATION OF VIRUSES IN ACTIVATED SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 5, p 1221-1224, May, 1982. 2 Fig, 26 Ref.

Descriptors: *Activated sludge process, *Viruses, *Wastewater treatment, Poliovirus, Microorganisms, Wastewater disposal, Waste disposal, Land disposal, Microbial degradation, Microbiological studies.

The role played by microorganisms in virus removal during activated sludge treatment was investigated. Mixed-liquor suspended solids (MLSS) of activated sludge were seeded with a standard enteric virus, and the loss of virus plaque-forming units (PFU) was measured over time. The virus used was the LSc2ab strain of poliovirus 1. The first experiment was done to determine the effect of MLSS on the recovery of poliovirus after different periods of incubation. The results indicated a rapid decrease in recoverable PFU occurring during the first 16 hr of incubation, relative to a control. The second experiment was done to determine the role of different MLSS components in virus loss. The MLSS were centrifuged, the supernatant was removed, and the pellet was suspended in an equal volume of distilled water. This suspension and the supernatant fraction were then seeded witn poliovirus. The loss of recoverable PFU was at least as rapid in the suspended pellet as in the original MLSS. The supernatant fraction intitially had almost no effect on virus recovery, but the expression of antiviral activity in this material became evident within 48 hr and progressed steadily through the 13 day incubation period. The third experiment was done to measure the effects of different disinfection methods on the antiviral activities in the pellet and supernatant fractions. Results indicated that MLSS contain a component which inactivates poliovirus, most likely a microorganism or group of microbial species. The identity of this organism, the mechanism by which it decreases poliovirus recovery, and its effect on other enteric viruses remain to be determined. (Baker-FRC)
W82-06739

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,
Kurita Water Industries Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 5A.
W82-06743

ISOLATION OF ENTEROVIRUSES FROM OXIDATION POND WATERS,
University of Southern Mississippi, Hattiesburg. Dept. of Microbiology.
V. L. Sheladia, R. D. Ellender, and R. A. Johnson.
Applied and Environmental Microbiology, Vol 43, No 4, p 971-974, April, 1982. 1 fig, 2 Tab, 14 Ref.

Descriptors: *Viruses, *Oxidation lagoons, Ponds, Enteroviruses, *Wastewater treatment, Oxidation, Lagoons, Seasonal variations, Aeration, Chlorination.

Enteroviruses were isolated from two types of oxidation lagoons. One lagoon complex involved 140 hectares of surface area, average input of 8000000 gallons/day, a retention time of 98 days, and effluent biological oxygen demand and suspended solids of 1,070 and 1,859, respectively. The other lagoon complex was smaller and processed a lower volume, employing mechanical aeration as well as effluent chlorination. Together the complexes serve about 45,000 people in primarily a light industrial area. During the 18 month study isolations, performed by sewage concentration and direct assay, were low in number and did not follow a seasonal trend. The newer treatment system, using aeration and effluent chlorination, was more efficient at removing viruses than the older, static complex. (Baker-FRC)
W82-06750

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, and B. Koopman.
Applied and Environmental Microbiology, Vol 43, No 4, p 964-966, April, 1982. 3 Fig, 16 Ref.

Descriptors: *Bacteria, *Activated sludge, Bacterial analysis, Sludge, Wastewater treatment, Activated sludge process, Chlorination, Wastewater analysis, *Pollutant identification, *Tetrazolium.

Bright-field microscopy and a new staining technique were used for the examination of the activity of filamentous bacteria in activated sludge after chlorine addition. A continuous-flow activated-sludge unit consisting of a 20-liter aeration basin with an integral clarifier was seeded with activated sludge culture from a wastewater treatment plant. The assessment of the activity of filamentous bacteria involved the incubation of activated sludge with 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride, followed by staining with malachite green. Both cells and 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride-formazan crystals can be observed in prepared specimens by using bright field microscopy. This method allowed the distinction to be made between inactive and actively metabolizing filaments after chlorine application to control the bulking of activated sludge. The procedure is simple, eliminates the use of epifluorescence, and allows the observation of inactive and active cells. (Baker-FRC)
W82-06752

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,
Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-06757

SEWER RENEWAL BY PIPE INSERTION.
For primary bibliographic entry see Field 8A.
W82-06759

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, and O. W. Prozesky.
Water Research, Vol 16, No 6, p 823-828, June, 1982. 4 Fig, 1 Tab, 31 Ref.

Descriptors: Water quality, *Reclaimed water, Drinking water, *Water reuse, *Wastewater renovation, Water supply development.

The quality of drinking waters originating from secondary effluents was investigated using the cloning efficiency technique. A comparison was made between direct and indirect reuse of wastewater in terms of their comparative efficiencies in removal of toxicants. Indirect reuse of wastewater was tested by investigating a system in which secondary effluents are discharge into a

river flowing into an artificial reservoir. After conventional treatment, water from this reservoir was supplied as potable water. Direct reuse was tested by studying the removal of toxicants by the unit processes in a water reclamation plant. Various stages of both the direct and indirect reuse systems were tested in order to determine which stage resulted in the greatest removal of toxicants. Judging from the results obtained by using the tissue culture cloning efficiency technique for testing both direct and indirect reuse of treated wastewater, both purification processes proved equally effective in removing most of the toxicants originally present in the secondary treated wastewater. The study suggests that reclamation of wastewater for direct reuse in arid regions can solve the problem of water shortages without increasing the health hazard to the consumer. (Baker-FRC)
W82-06768

THE KINETICS OF HEXAVALENT CHROMIUM REDUCTION BY METALLIC IRON,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould.
Water Research, Vol 16, No 6, p 871-877, June, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Chromium, Industrial wastes, Cooling towers, *Kinetics, Chemical reactions, *Iron, Chemical reduction, Oxidation-reduction potential.

The use of metallic iron as a reductant for Cr(VI) is reported. Metallic iron reacted efficiently with Cr(VI) under acid conditions in a complex reaction. Reaction kinetics were 0.5 order in both hydrogen ion and hexavalent chromium and first order in iron surface area. Since the iron consumed is proportional to the Cr(VI) concentration, careful system design will obviate the need for measuring and dispensing various treatment chemicals. Substantially less iron is needed to reduce a given quantity of Cr(VI) than would be the case for Fe(2+). In effect, each iron molecule provides 1.5-2.5 electrons in the reduction rather than the single electron available from the ferrous iron. The highly efficient utilization of iron in the reduction suggests that hydrogen generated during iron dissolution may be acting as a reductant for the Cr(VI). Since iron utilization efficiency improves as Cr(VI) concentration increases, such a treatment system implies that a significant advantage will be associated with segregation of high concentration Cr(VI) bearing wastes. The resulting effluent containing ferric ion and the relatively non-toxic chromic ion might be usable as a coagulant where needed. (Baker-FRC)
W82-06771

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Enginerring.
R. M. Kabrick, and W. J. Jewell.
Water Research, Vol 16, No 6, p 1051-1060, June, 1982. 4 Fig, 4 Tab, 38 Ref.

Descriptors: *Pathogens, *Sludge digestion, *Digested sludge, Bacteria, Coliforms, Viruses, Parasites, Wastewater treatment, Salmonella, Pseudomonas, Anaerobic digestion, Thermophilic digestion, Mesophilic digestion.

The effect of two types of sludge digestion on pathogen survival was studied in two full-scale, continuous systems: autoheated aerobic thermophilic digestion and conventional mesophilic anaerobic digestion. The aerobic digester was operated at 45-65 C and variable loading conditions. the anaerobic digester was operated at a constant temperature of 35 C and constant loading rates. Mean bacterial counts per 100 ml of wet sludge were: feed sludge, 37 million fecal coliforms and 27 million fecal streptococci; anaerobic sludge, 840,000 fecal coliforms and 930,000 fecal streptococci; and aerobic sludge, 18,000 fecal coliforms and 82,000 fecal streptococci. The aerobic digester reduced Salmonella sp. to nondetectable levels and pseudomonads to lower levels except for one sampling date on which the digester was operating poorly. The anaerobic digester reduced Salmonella sp. and pseudomonads less efficiently. The aerobic digester reduced viruses to the nondetectable level, and the anaerobic reduced viruses as much as 98.6%. The aerobic process did not completely eliminate parasitic ova, but it was more effective than the anaerobic process. The thermophilic aerobic digester can be improved by using series-fed reactors or sequencing batch units to compensate for inadequate temperatures during start-up or shut-down. (Cassar-FRC)
W82-06772

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 5G.
W82-06775

EFFECT OF CARBON-OXYGEN AND CARBON-SULFUR SURFACE COMPLEXES ON THE ADSORPTION OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS BY ACTIVATED CARBONS,
Universidad Nacional de Educational a Distancia, Madrid (Spain).
J. de D. Lopez-Gonzales, C. Moreno-Castilla, A. Guerrero-Ruiz, and F. Rodriguez-Reinoso.
Journal of Chemical Technology and Biotechnology, Vol 32, No 5, p 575-579, May, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Carbon, *Adsoprtion, *Wastewater treatment, *Mercuric chloride, Chlorides, Acidity, *Activated carbon, Water treatment, Temperature effects.

The adsoprtion of mercuric chloride from aqueous solution onto activated carbons previously treated to introduce carbon-oxygen and carbon-sulfur surface complexes was studied to determine their effect on the adsorptive capacity of the original carbons. The findings demonstrated that the existence of hydroquinone, phenolic and hydrosulfide groups on the surface of the carbon caused reduction of Hg(II) to Hg(I). However, there was an increase in the adsorption of Hg(II) when sulfide or hydrowulfide groups were present on the surface of the carbon. The effect of the pH of the solutions on mecuric chloride adsorption was also studied. When the pH was changed from 1 to 7 the adsorption of mercuric chloride by the activated carbons was enhanced. (Baker-FRC)
W82-06788

ELECTROPLATING AND CYANIDE WASTES,
Virginia Poly..chnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and J. Kunjur.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6 p 733-737, June, 1982. 45 Ref.

Descriptors: *Literatuure reviews, *Electroplating, *Metal-finishing wastes, *Cyanide, wastes, Industrial wastewater, *Wastewater treatment, Metals, Heavy metals, Regulations, Chemical precipitation, Sludge dewatering, Sludge disposal, Chromium, Copper, Nickel, Zinc, Membrane processes, Wastewater analysis, Ozonation, Aeration, *Reviews.

A review of recent literature on electroplating and cyanide wastes included several topics: regulatory aspects, heavy metals treatment and recovery, cyanide detection and treatment, and sludge treatment and disposal. In general, effluent standards became less stringent and more flexible during 1981. Some compliance dates were extended, and pretreatment standards for electroplaters generating less than 38,000 liters per day of waste flow were established. Many papers concerned heavy metals treatment. Among the newer or better methods mentioned were carbonate precipitation, soluble sulfide precipitation, amine ligands for Cu and Ni precipitation, sodium hydroxide precipitation, sodium borohydride, electrocoagulation, reverse osmosis, ultrafiltration, and adsorption on a confined soil bed. Developments in cyanide determination included the use of sodium ethylenediamine tetraacetic acid for masking interfering ions, polarographic methods for low levels (< 0.1 mg per liter) of cyanide, and automatic monitoring of cyanide and other wastewater constituents. Cyanide waste treatment methods discussed were high temperature and high pressure hydrolysis to convert cyanide to ammonia and formate, use of iron sulfide compounds, percolation through mixed pyrrhotite-pyrite, oxygen/hydrogen catalytic treatment, fixed bed columns containing ceramic material or graphite, ozonation, and hydrolytic assist extended aeration. Sludge treatment and disposal innovations were a new silicate material for concentrating sludge, use of sludge as an admixture for concrete, metals immobilization by acid fixing in a proprietary siliceous polymer and solidification in cement, and immobilizing chemicals such as lanthanum compounds, Magnesium chromate, ferrite sludges, and a carbonate/silicon oxide mixture. (Cassar-FRC)
W82-06798

STEEL INDUSTRY WASTES,
Canada Centre for Inland Waters, Burlington (Ontario).
D. T. Vachon, J. W. Schmidt, and N. W. Schmidtke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 729-733, June, 1982. 61 Ref.

Descriptors: *Steel industry, wastes, *Literature reviews, *Metal-finishing wastes, *Industrial wastes, *Reviews, *Wastewater treatment, Coke, Biological treatment, Water reuse, Nitrification, Thiocyanates.

A review on the characteristics and treatment of steel industry wastes included general papers and reports on coke production, iron and steel making and forging, pickling operations, and metal finishing processes. An additional $10 billion in pollution control equipment is projected for this industry by 1989. As effluent limitations become more stringent, the cost effectiveness of control measures decreases. Recycling and recirculation are becoming increasingly important. Research on wastewater from coke production effluents concerned alkaline chlorination with filtration and dechlorination, thiocyanate removal by ion exchange, ozonation, treatment with long chain quaternary amines to remove iron cyanides, stripping in a distillation tower, removal of oil and grease with coagulation/flocculation/dissolved air flotation/caustic soda treatment, biological treatment, biological nitrification, use of activated carbon in nitrification/denitrification, and mixing at 10% with municipal wastewater. Several processes were successful in treating blast furnace gas cleaning wastewater, steel manufacturing wastewater, pickling effluents, and metal processing wastes.(Cassar-FRC)
W82-06799

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
M. F. Torpy, and E. L. Stover.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 726-729, June, 1982. 2 Tab, 30 Ref.

Descriptors: *Literature reviews, *Oil shale, *Synthetic fuels, *Coal gasification, *Reviews, Fuel, Toxicity, Water pollution effects, Wastewater analysis, Biological treatment, Tar sands, Waste disposal, Fate of pollutants, *Wastewater treatment.

A review of synthetic fuel effluents and their impact on water quality reveals that several meetings and symposia included information on this subject. Several waste stream treatment methods were mentioned--a separate biological nitrification unit to handle high thiocyanate levels, ammonia stripping, solvent extraction, and wet air oxidation. Coal liquefaction products were more toxic to

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fresh water algae than shale oil products and petroleum products. Topics in the field of oil shale and tar sands were studies: the wet scrubbing system; water reuse options; adsorption of retort water by soil; chemical characterization of effluents, up to 238 constituents identified; methods of determining ammonia; mobility of trace elements; treatment of wastewater by biological treatment, reverse osmosis, or evaporation; mutagenicity of effluents; solids disposal problems; migration of organic constituents through the soil; and vegetative stabilization of retorted shales. (Cassar-FRC)
W82-06800

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and M. F. Torpy.
Journal of the Water Pollutin Control Federation (Literature Review Issue), Vol 54, No 6, p 723-726, June, 1982. 52 Ref.

Descriptors: *Literature reviews, *Oil refineries, *Hydrocarbons, *Industrial wastes, *Wastewater treatment, Petroleum products, Oil industry, Oil wastes, Organic compounds, Membrane processes, Oil shale, Activated carbon, Coagulation, Land disposal, Sludge, Water polution prevention, *Reviews.

Recent work on the environmental effects and treatment of petroleum processing wastes was reviewed. Characterization of wastewater effluents showed that priority pollutants were associated with certain products and processes that use certain precursors and generic process combinations. Sour condensates from conventional crude oil cracking produced straight chain alkanes, and pyridines and anilines were present in shale oil sour condensates. Heavy metal levels were low in most process effluents. The oil/water separation techniques data base has been updated by the American Petroleum Institute to include 166 citations. New papers in this field concerned the use of flocculation and flotation, electrochemical purification, electroflotation-coagulation, and an emulsion breaker/alum system. Biological wastewater treatment plants at several refineries were described. Special topics included carbon dioxide treatment of spent alkalis in refinery wastewater to decrease phenols and sulfur compounds and use of activated carbon. Several papers discussed the special problems of shale oil wastewater. Methds of protecting streams and groundwater in tar sands regions included monitoring, toxicity testing, and spill prevention. Petroleum refinery wastewaters were also treated by several membrane processes. Sludges were handled by solidification with hydrophobically adjusted Ca-containing chemicals, reuse in sealants and roofing or as fuel, and land disposal and microbial degradation. (Cassar-FRC)
W82-06801

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
T. W. Siegrist.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 737-749, June, 1982. 152 Ref.

Descriptors: *Literature reviews, *Chemical wastewater, *Industrial wastewater, *Organic compounds, *Reviews, Wastewater treatment, Activated carbon, Adsorption, Phenol, Polychlorinated biphenyls, Chlorinated hydrocarbons, Incineration, Biodegradation, Pesticides, Physiocochemical treatment, Metals, Oxidation, Surfactants, Activated sludge process, Biological treatment, Drugs, Encapsulation, Nitrification, Microorganisms, Ultrafiltration, Membrane processes.

A review of recent literature on wastewater treatment in the chemical industry was organized according to product type and type of treatment (source, biological, and physical/chemical). For treating phenol and mixtures the following techniques were tried: anaerobic granular activated carbon bioreactors, anaerobic fixed-film bioreactors packed with granular activated carbon, carbon-sulfur compounds, liquid membranes, electrochemical oxidation, and horseradish peroxidase and hydrogen peroxide. Polychlorinated biphenyls and related chlorinated compounds were degraded or removed by incineration, chemical dechlorination, ultraviolet-ozone treatment, ultraviolet-light irradiation, polyurethane foam filtration, a particulate elastromeric polymer, algae, and microorganisms. Pesticides production wastewaters were treated by microbial degradation and a variety of chemical techniques specific to the nature of the wastewater. In addition papers on treatment of wastewaters from paint and ink plants, pharmaceutical manufacture, chlorinated organic wastes, detergent manufacture, and dozens of miscellaneous organic chemicals were summarized. Many waste products were recovered, some for sale, from process streams, for example, recovery of naphthalene hydrocarbons from petrochemical wastewater by adsorption on activated carbon and recovery of dispersed elemental Hg used as the oxide as a catalyst in vinyl acetate production by treatment with hydrazine hydrate. Biological treatment, especially with adapted activated sludges, was used for many chemicals. Powdered activated carbon, closed pure oxygen systems, and genetically-engineered microorganisms were among the modifications to the activated sludge process. Many studies were done on the factors affecting the activated sludge process. (Cassar-FRC)
W82-06805

SIMPLIFIED CLARIFIER AXES TREATMENT STAGES,
World Water, Vol 5, No 5, p 22-23, 25, May, 1982. 6 Fig.

Descriptors: *Clarification, *Oxidation ditches, *Biological treatment, *Wastewater treatment, Little Blue Valley Sewer District, Jackson County, *Missouri, Pilot tests, Design criteria, Land application, Aeration, Aerobic digestion, Dewatering, Sludge disposal.

The Little Blue Valley Sewer District biological sewage treatment plant in Jackson County, Missouri, was ranked as one of 1982's ten outstanding engineering achievements by the National Society of Professional Engineers. The 5000 cu m per day pilot plant uses only 6 of 13 originally planned treatment components to reduce costs to a minimum. The unconventional process comprises screening, oxidation ditch with integral clarification device, sludge waste pump, aerobic digester with integral clarification device, sludge dewatering, and land application. The heart of the simplified system is an intrachannel clarification device which eliminates the secondary clarifier and the secondary return sludge pump and piping. A section of the oxidation ditch opposite the aerator is deepened and partially blocked to force the normal ditch flow downwards, creating a quiescent zone for clarification. V-section cross pieces isolate the quiescent zone from the normal mixed liquor flow beneath, allowing mixed liquor to pass upward through the sections. Sludge falls back into the mixed liquor flow. Effluent is drawn from near the surface of the quiescent zone. Further experience showed that the grit removal step was also unnecessary. Average effluent BOD5 is 10-25 mg per liter with detention times as low as 6 hours. (Cassar-FRC)
W82-06820

THE REMOVAL OF MIXTURES OF METALS BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 683-693, April, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Flotation, *Metals, *Foam separation, *Separation techniques, Industrial wastewater treatment, *Wastewater treatment, Zinc, Copper, Chromium, Heavy metals, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation, Aluminum hydroxide, Ferric hydroxide, Economic analysis, Costs, Lime, Chemical precipitation.

A foam flotation pilot plant removed Cu(+++), Zn(++), and Cr(3+) from a simulated industrial wastewater containing 20 mg per liter each of these ions. At optimal conditions the residual levels of the ions were: Cu, < 1 mg per liter; Zn, 0.5 mg per liter; and Cr, 0.2 mg per liter. Hydraulic loading rates were 6.9 cu m per sq m per hour; air flow rate, 14 N cu m per sq m per hour; pH, 7.0-8.0; Fe(3+) as a flocculant, 100-115 mg per liter; Al(3+) as a flocculant, 75-100 mg per liter; and sodium lauryl sulfate foaming agent, 25-30% of total Fe and Al dose by weight. Economic analysis showed that adsorbing foam flotation could remove metals at a cost of 51 cents per 1000 liters vs. 60 cents per 1000 liters for a lime precipitation plant. This did not include the expensive filtration step and the 8 times greater area required for the lime precipitation process. (Cassar-FRC)
W82-06821

REMOVAL OF ZINC BY ADSORBING COLLOID FOAM FLOTATION: PILOT PLANT STUDY,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 673-682, April, 1982. 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Flotation, *Foam separation, *Separation techniques, *Metals, *Zinc, Copper, Aluminum hydroxide, Hydraulic loading, Heavy metals, Industrial wastewater treatment, *Wastewater treatment, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation.

A foam flotation pilot plant removed zinc from a simulated industrial wastewater containing 20 mg per liter Zn(++). Effluent Zn concentrations were below 1 mg per liter when the following optimum parameters were used: pH, 7.5-7.8; Al(3+) as aluminum hydroxide, 100 mg per liter; sodium lauryl sulfate surfactant, 30-40 mg per liter; hydraulic loading rate, 6.9-13.8 cu m per sq m per hour; and air flow rate, 12-13 N cu m per sq m per hour. Optimum Al(3+) dose depended on the influent Zn(++) concentrations. To produce effluent Zn(++) concentrations of < 1 mg per liter, a 50 mg per liter Al(3+) dose was sufficient for influent Zn(++) of 10 mg per liter concentration, and 150 mg per liter Al(3+) was necessary for influent Zn(++) of 30 mg per liter. Substituting Fe(OH)3 for Al(OH)3 and Cu(++) for Zn(++), trends were similar but residual Cu(++) was lower. Increasing ionic strength above 0.05M was detrimental to Zn(++) removal. (Cassar-FRC)
W82-06822

CONTINUOUS DENTRIFICATION BY IMMOBILIZED CELLS (DENITRIFICATION EN CONTINU A L'AIDE DE MICROORGANISMES IMMOBILISES SUR DES SUPPORTS SOLIDES),
Departement de Genie Biochimique, Tolouse (France).
M. Vossoughi, M. Laroche, J. M. Navarro, G. Faup, and A. Leprince.
Water Research, Vol 16, No 6, p 995-1002, June, 1982. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Denitrification, *Wastewater treatment, Nitrates, Nitrogen, Nitrification, Kinetics, Chemical reactions, Colorimetry, *Biological wastewater treatment, Pseudomonas, Bacteria.

A study of biological denitrification by immobilized cells is described. Nitrates are reduced in sterile solutions by Pseudomonas aeruginosa immobilized in a fixed bed reactor, and in synthetic wastewater by mixed cultures immobilized in a fluidized bed reactor. The fixed bed reactor was a Plexiglas column filled with corn stovers. Nitrates and nitrites were determined by a colorimetric method. The reactor efficiency remained constant for over 40 days. Nitrates and nitrites were measured inside the reactor for flow varying from 2 to 16 ml/minute. Reductions of nitrates and nitrites seem to be two first-order reactions, and the constant rate increases with flow rate. The fluidized bed reactor used was a Plexiglas column filled with earthenware. The reduction of nitrates and nitrites

again appeared as two first-order reactions, and the constant rate values, higher than in fixed bed reactors, increased with flow. The reactor was more greatly affected by a flow shift than by a nitrate concentration shift in fresh medium; the biomass bound to the carrier was about 76 mg of dry matter/g of earthenware. The fluidized bed column was able to reduce 560 mg of nitrate nitrogen/hr/liter of empty reactor, with a liquid retention time of less than 3 minutes. (Baker-FRC)
W82-06830

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
York Univ. (England). Dept. of Biology.
N. V. Ashley, M. Davies, and T. J. Hurst.
Water Research, Vol 16, No 6, p 963-971, June, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Anaerobic digestion, *Nickel, Microorganisms, *Biological treatment, Digestion, Biodegradation, Anaerobic conditions, Sludge digestion, Activated sludge process, *Wastewater treatment, Water pollution effects, Metals, Heavy metals.

The effects of increased nickel ion concentrations on physiological groupings of microorganisms were examined to determine the toxic effects upon the degradative populations of bacteria in an anaerobic digester and to estimate a realistic toxic level of nickel in a population of organisms adapted to it by prolonged exposure at relatively low concentration. The concentration of dissolved nickel remained low (0.35 to 1.1 mg/liter) following addition of nickel at 25 and 50 mg/liter to the digester feed, presumably due to much of the nickel being present as the sparingly soluble sulfide or otherwise bound. At progressively higher additions (100, 150 and 250 mg/liter) the dissolved nickel increased substantially, probably due to a depletion in the available sulfide levels caused by the earlier nickel addition. The maximum dissolved nickel level obtained was 15 mg/liter. The nickel had exerted appreciable toxicity below this concentration. The nickel level in the control digester never exceeded 0.2 mg/liter. There appeared to be only a slight increase in relative numbers of acid producing organisms in the digester at low nickel additions, more so at a level of 50 mg/liter. The populations of amylolytic bacteria exhibited an initial increase in relative number with changes in nickel additions, followed by a decrease in number Apart from these growth-stimulating effects at initial addition, the major effect of nickel was to lower the amylolytic bacterial population to a level below that of the control digester. The populations of proteolytic organisms were generally higher in the nickel challenged digester than in the control. A marked increase in the proleolytic population was found with the addition of 100 mg/liter of nickel, after which the population decreased, only to increase again under the influence of a further nickel increase. Nickel apparently favors a degradative population of bacteria primarily adapted to amino acid fermentation and inhibits carbohydrate metabolism in a population of proteolytic and amylolytic bacteria. (Baker-FRC)
W82-06832

BASIC STUDIES ON CARBON DIOXIDE/AIR CONTROL SYSTEM FOR ACTIVATED SLUDGE PROCESSES,
Hitachi Ltd., Ibaragi (Japan).
S. Nogita, S. Watanabe, and K. Baba.
Water Research, Vol 16, No 6, p 1017-1024, June, 1982. 14 Fig, 6 Tab, 4 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Carbon dioxide, Oxygen, Dissolved oxygen, Sludge, Municipal wastewater, Aeration tanks.

Basic facts about the production of carbon dioxide by activated sludge in an aeration tank are summarized, and the experimental results obtained with a carbon dioxide/air control system are reported. A continuous-flow-type apparatus was used to gather the data. Under the given conditions of the experiment the composition of the inflow and the air flow rate had little effect on the carbon dioxide production rate of activated sludge, and the carbon dioxide production rate was a function of the organic load. Since the organic load change caused a change in the carbon dioxide production rate in minutes instead of hours, a carbon dioxide/air control system in an activated sludge pilot plant was used to study carbon dioxide production. A control system was developed which effectively stabilized the carbon dioxide concentration. It was concluded that a carbon dioxide/air control system that can maintain a dissolved oxygen concentration within 0.5 mg/liter of a selected value functions in the same way as a dissolved oxygen/air control system, when exhausted air is analyzed in the former system. The system tested maintained the carbon dioxide concentration within 0.000.5 vol% of a selected value with a typical diurnal sewage flow rate pattern and maintained the dissolved oxygen content in mixed liquor within 0.4 mg/liter of a selected value. (Baker-FRC)
W82-06833

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,
California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
P. S. K. Leung, and N. J. Sell.
Water Resources Bulletin, Vol 18, No 3, p 495-502, June, 1982. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Water quality, *Pulp and paper industry, *Pulp wastes, Industrial wastes, Fox River, *Wisconsin, Water pollution sources, Water pollution control, Biological oxygen demand, Suspended solids, Dissolved oxygen, Toxicity, Organic chemicals, *Wastewater treatment, Primary wastewater treatment, Secondary wastewater treatment.

Eighteen paper mills, producing greater than 5300 tons of paper per day, located along the Lower Fox River, Wisconsin, were asked to participate in a study of the effectiveness of the waste treatment methods each employed. Nine plants agreed to participate. On-site visits were made and discussions held with appropriate management and operating personnel. Technical data regarding the general operation of the plant, water pollutants, and methods for primary and secondary treatment were included in the study. In general the paper companies without any pulping processes or which produce relatively small quantities of paper per day either install only the primary treatment system or send the waste stream to a nearby municipal system. Companies with pulping processes or large quantities of paper being produced usually also install a secondary treatment system. Primary treatment is basically a settling pond. The overall efficiencies of these primary treatment systems are about 95% and 30-55% for removing suspended solids and BOD, respectively. Secondary treatment in all cases consisted of activated sludge systems, including an aeration tank where most of the microbiological activity occurs and a secondary clarifier where the activated sludge settles out. The maximum temperatures of the discharges reached 110 F, although most effluents ranged from 70 to 90 F. All plants discharged only about 40-50% of the allowable suspended solids. Similarly, most discharged less than 50% of the allowable BOD. Even so, the water quality of the river, particularly as regards dissolved oxygen, remains unsatisfactory at times. Several types of regulatory changes are possible. Flow and temperature related permits would probably be the most effective in improving DO levels, but would also be the most difficult to comply with. (Baker-FRC)
W82-06870

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-06890

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Calocerinos and Spina Co., Liverpool, NY.
P. E. Moffa, S. D. Freedman, E. M. Owens, R. Field, and C. Cibik.
Journal of the Water Pollution Control Federation, (Literature Review Issue). Vol 54, No 6, p 675-677, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Urban runoff, *Combined sewer overflows, *Storm water, *Reviews, Model studies, Detention basins, Water management, Storm wastewater, Wastewater treatment, Rainfall, Monitoring, Water quality, Trace metals, Copper, Lead, Zinc, Settleable solids.

A review of urban runoff literature dealt with characteristics, impacts on receiving waters, control, treatment, and management. The great variability of storm water quality was handled by some simplified modeling and monitoring techniques and other methods of estimating pollutant levels and impact on receiving waters. Snowmelt was lower in nutrients, but higher in total solids, oil and grease, and colloidal material, than was rainfall runoff. It was estimated that combined sewer overflows and surface runoff contribute 30% of BOD and 74% of suspended solids discharged from municipal sources. Models and planning methods were also developed for aiding in design of storm water storage and treatment systems. Treatment considerations included underground circulation systems, facultative lagoons, biological treatment, sewer flushing, polymer injection, flow regulations, and upstream storage. In settleability tests hydrocarbon, lead, and total suspended solids were reduced by 70% over 32 hours; BOD, Cu, and Ni settled more slowly, 20-50% in the same time; and Zn settled the slowest. Methods of estimating flow rates for managing storm water flows included use of digital recording weather radar, computer based models, and statistical techniques. (Cassar-FRC)
W82-06914

TEXTILE WASTES,
Krebs (Paul B.) and Associates, Inc., Birmingham, AL.
J. F. Judkins, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 702-704, June, 1982. 25 Ref.

Descriptors: *Literature reviews, *Industrial wastewater, *Textile mill wastes, *Dyes, *Wastewater treatment, *Reviews, Wool scouring, Polymers, Ultrafiltration, Membrane processes, Textiles, Fabrics, Wool, Dye industry wastes, Ozonation, Activated sludge process, Flocculation, Chemical coagulation.

Recent literature on treatment and disposal of textile wastes described processes for handling dyeing wastewaters, wool scouring effluents, synthetic fiber wastewaters, and polymeric sizing agents. Good results were obtained from unspecified textile wastewaters by alum coagulation, followed by activated sludge treatment and by powdered activated carbon treatment. Dyeing wastewaters were successfully treated with alum and organic polymers, ozonation (acid and direct dyes), recovery of dyes without changing their chemical nature, electrochemical treatment of acid monoazo dyes, and landfilling of concentrated dyes with hypochlorination of dilute dye effluents. Techniques used for wool scouring effluents were a horizontal decanter centrifuge with addition of bittern flocculant or MgCl2; a hot acid flocculation process; solvent extraction of wool wax from dewatered sludge; activated sludge process; a Humboldt Sl-1 decanter; a physical-chemical process consisting of chlorination, electrocoagulation/flotation in acid, neutralization and further flotation; and separation of waste streams to reduce the organic load to the biological treatment process. Several synthetic fiber plants initiated recycling of wastes treated by coagulation/filtration/adsorption/ozonation, activated carbon adsorption, or flotation. Ultrafiltration was effective in recovery of polymeric sizing agents. Zirconium oxide, cellulose acetate, and polyamide membranes were considered. Water reuse treatments for polymer size recovery included high-temperature ultrafiltration, hypofiltration, and coagulation with recovered salt solutions. Kapron

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and nylon-548 production wastes were polymerized to form glue-type polymers with excellent adhesion properties. (Cassar-FRC)
W82-06916

FERMENTATION INDUSTRY,
Notre Dame Univ., IN., DepT. of Civil Engineering.
S. C. Chiesa, R. L. Irvine, and J. F. Manning, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 695-700, June, 1982. 70 Ref.

Descriptors: *Literature reviews, *Fermentation, *Industrial wastewater, *Wastewater treatment, *Reviews, Anaerobic digestion, Aerobic treatment, Biomass, Feeds, Methane, Drugs, Antibiotics, Fertilizers, Yeasts, Fuel.

Recent work on treatment of fermentation wastes was reviewed. In addition to reuse, recycling and recovery techniques such as production of ethanol, methane, biomass, animal feed, fertilizers, and building materials, other treatment alternatives were proposed. Brewery wastewaters were treated with activated sludge and biological filters, dilution with municipal wastewater, adsorption of heavy metal ions on immobilized tannin, the aeroaccelator system (high-rate biological treatment), bacterial methods, pure oxygen activated sludge, and anerobic processes. Common biological treatment methods were successful in treating yeast factory wastewaters; high temperature and metallic catalysts were tried by one investigator. Several investigators characterized distillery wastes. Treatment methods included incineration, composting, extended aerobic biological treatment, anaerobic treatment (contact process and two-phase system), and the Anamet anaerobic/aerobic process. Winery wastewaters were purified by electrochemical means or with yeast cells. Shock chlorine doses controlled excessive foaming and bulking in an activated sludge system. Pharmaceutical wastes were treated by a variety of methods depending on the nature of the pharmaceutical process: ammonium ions were removed by physical/chemical treatment with clinoptiolite; organic solvents, by Amberlite resins; antibiotics, by coagulation with ferrous sulfate and polyacrylamide and centrifugation or combustion; and tellurium oxide, by reduction with SnC12 and coprecipitation with ferric hydroxide. Several references dealt aerobic and/or anaerobic treatment of wastes. Removal efficiencies of 26 priority pollutants were compared for several treatments, the best of which was activated sludge with added activated carbon. (Cassar-FRC)
W82-06917

FRUIT, VEGETABLE, AND GRAIN PROCESSING WASTES,
Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL.
R. A. Morrell, and H. E. Schmidt, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 692-695, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Fruit crops, *Vegetable crops, *Industrial wastewater, *Reviews, *Wastewater treatment, Biological treatment, Activated sludge process, Anerobic digestion, Lagoons, Wastewater lagoons, Filtration, Water pollution prevention, Land disposal, Grain crops, Canneries.

Two books and an operations manual for biological treatment were among the new literature on food processing wastes. Several papers on treatment processes for a variety of food wastes included information on a lamella-type separator for removing suspended solids, a low-load activated sludge wastewater treatment plant for combined domestic and food wastes, and the application of land disposal techniques. Treatment systems designed for fruit wastes included a highly loaded two-stage stone media biofilter. Tomato waste treatments included a physical-chemical system with aeration and carbon filter bed, as well as spray irrigation, land application, and anaerobic digestion. For citrus wastes methane fermentation was discussed. The following processes and equipment were developed for handling wastewaters from vegetable processing: a rotating drum screen for liquid-solid separation and a blancher using steam that produces one-tenth the volume of effluent and one-fourth the BOD levels. For beet sugar wastewaters suggestions included Fe coagulation/flocculation, vacuum filtration, treatment in a municipal plant after pretreatment, and irrigation with effluent. For potato wastewater use of a horizontal anaerobic filter with 90% BOD removal, 2 anaerobic lagoons in parallel followed by anaerobic filter and aeration were considered. Controlled culture fermentation was successful in treatment of pickle, greens, olive, and bean processing liquids. An experimental washer for greens produced lower pollutant levels than an industrial washing system. Olive processing wastes were composted in a tank containing soil. Bean-blanching wastes were treated in anerobic fixed film reactors. (Cassar-FRC)
W82-06918

DAIRY WASTES,
Kraft, Inc., Glenview, IL.
J. C. Groenewold.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 700-702, June, 1982. 47 Ref.c

Descriptors: *Literature reviews, *Dairy industry, *Food-processing wastes, *Industrial wastewater, *Reviews, Wastewater treatment, Regulations, Economic aspects, Legislation, Biological treatment, Lagoons, Fermentation, Membrane processes, Land disposal, Wastewater disposal, Activated sludge process, Animal wastes, Bacteria.

A review of the past year's information on treatment of dairy wastes listed several general papers: the types of dairy wastewater treatment in Poland; literature reviews, including pollution from milk losses (considered trivial), and sampling and flow measuring techniques. Other general subjects included combined municipal-dairy effluent treatment and the unit processes of an ideal dairy waste treatment system. Among the papers on regulations, legislation, and economics, several favored land applicatiion. Whey disposal options included fermentation, land disposal by spraying, animal feed production, extraction of lactose and other useful components, and reverse osmosis followed by evaporation or ultrafiltration. Several case histories were described. The nutrient application in long-term land disposal should not exceed the nutrient amounts removed as forage. A biospiral system and drum filter tertiary treatment unit for creamery effluent reduced BOD to 3 mg per liter. Other treatment systems in actual use were anaerobic-aerobic lagoons, bacterial bed treatment using a variety of media, extended aeration, and physical-chemical treatment. Research efforts involved combined farm waste-milk waste lagooning, a rotating biological contactor, a multistage bubble separator, pretreatment and discharge into the municipal system, enzymatic prehydrolysis (unsuccessful), the effect of light wavelength on bacterial production of ethanol, characterization of various dairy wastes, and isolation of a new bacteria from dairy waste activated sludge. (Cassar-FRC)
W82-06921

ANAEROBIC PROCESSES,
Institute of Gas Technology, Chicago, IL.
K. F. Fannin, J. R. Conrad, V. J. Srivastava, D. E. Jerger, and D. P. Chynoweth.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 612-623, June, 1982. 1 Tab, 130 Ref.

Descriptors: *Literature reviews, *Anaerobic conditions, *Reviews, Agricultural wastes, Digestion, Anaerobic digestion, *Wastewater treatment, Municipal wastewater, Industrial wastes, Bacteria, Microbiological studies, Methanogenesis, Design criteria, Economic aspects.

Recent research in the area of anaerobic processes is cited in this literture review. Reviews published dealing with the entire subject included works on the status of work in the United States on biomass and waste-to-energy processes and various digester types used in European farm anaerobic digestion before 1970. In the area of microbiology papers dealing with classification and characterization included efforts made toward the isolation of a filamentous, facultative anaerobic microorganism which attached lignified tissue in forage grasses, on the diversity of microorganisms involved in cellulose fermentation, and on the electrical potential and intracellular pH of two methanogenic bacteria. Microbiology papers also dealt with cellulose hydrolysis, acidogenesis, and methanogenesis. Process stability was considered in studies dealing with acid and alkaline phosphatase activity used as biochemical predictors of digestor failure. Process optimization research dealt with general methodology, attached-film reactors, sludge bed reactors, two-phase reactors, stirred-tank reactors, peat and landfill digestion, and ethanol fermentation. Energy and economic assessment was also considered. Process application research centered on municipal wastewater studies, municipal solid wastes, process wastes, and agricultural wastes. Patents which were obtained are briefly noted. (Baker-FRC)
W82-06923

MICROBIOLOGY: WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA., Dept. of Biological Sciences.
W. O. Pipes, and H. A. Minnigh.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 987-989, June, 1982. 45 Ref.

Descriptors: *Literature reviews, *Wastewater treatment, *Reviews, Activated sludge process, Sludge, Sludge disposal, Land disposal, Industrial wastes, Bacteria, Stabilization ponds, Anaerobic condition, *Microbiological studies, Nutrients, Phosphorus removal.

Recent research in the field of wastewater treatment is cited in this literature review. Microbiological oxidation of reduced nitrogen compounds in aerobic wastewater treatment processes and particularly the conditions that lead to inhibition of such oxidation were topics of research in 1981. Interactions among microorganisms in anaerobic sludge digestion were also reported. Activated sludge research centered on the isolation of floc-forming bacteria from activated sludge on casitone-glycerol-yeast extract agar, on a laboratory model flocculation system based on pure cultures of Escherichia coli, on cell residence time and its influence on microbial composition of activated sludge produced in a completely mixed laboratory system of treated domestic wastewater fortified with sugars and organic acids, on hydrazine inhibition of Nitrobacter and Nitrosomonas in activated sludge, on absorption of uranium and thorium by activated sludge, and on the occurrence of cysts of Entamoeba histolytica and Giaridia lamblia and the ova of Ascaris, Trichuris, and Hymenolopsis in wastewater and effluents from activated sludge systems in India. Stabilization ponds were studied concerning their effectiveness in wastewater treatment for nitrogen and phosphorus removal and for reduction of virus content. Land disposal was examined with regard to Salmonella havana persistence. Sludge treatment processes were investigated using staged anaerobic digestion, and included work on the formation of diethyl amine from creatinine in digesting wastewater sludge and on the survival of microorganisms after anaerobic digestion and prolonged periods of lagooning. Industrial wastes were also considered. (Baker-FRC)
W82-06926

PRELIMINARY STUDIES ON THE DEWATERING OF COAL-CLAY WASTE SLURRIES USING A FLOCCULANT,
Bureau of Mines, Tuscaloosa, AL. Tuscaloosa Research Center.
J. R. Zatko, B. J. Scheiner, and A. G. Smelley.
Report of Investigations RI 8636, 1982. 18 p, 7 Fig, 9 Tab, 6 Ref.

Descriptors: *Mine wastes, *Dewatering, *Slurries, *Flocculation, Coal mining, Clays, Water reuse, *Wastewater treatment, Polyethylene oxide.

In the preparaton of coal to produce low-ash material, a waste product containing fine coal and clay is generated. This waste product, generally minus 28 mesh in size with the major portion being minus 325 mesh, is difficult to handle due to the slow settling of the fine-sized clay particles. In laboratory-scale and small-scale continuous tests, coal-clay waste slurries from two commercial preparation plants were dewatered using polyethylene oxide (PEO) as a flocculant. Slurries containing up to 50-wt-pct solids using 0.5 lb of PEO per ton of feed solids in small-scale continuous tests. The tests also indicated that a pH of at least 9 was required for West Virginia slurry, while a pH of 7 for the Alabama slurry was adequate. Initial solids content had little effect on dewatering. Water recovered from dewatering was used as dilution water for 0.25-wt-pct PEO solutions without any deleterious effect. (Moore-SRC)
W82-06958

ELECTROKINETIC DENSIFICATION OF SOLIDS IN A COAL MINE SEDIMENT POND-A FEASIBILILTY STUDY, (IN TWO PARTS), 1. LABORATORY AND FIELD TESTS,
Bureau of Mines, Spokane, WA. Spokane Research Center.
R. H. Sprute, and D. J. Kelsh.
Report of Investigations RI 8666, 1982, 36 p, 15 Fig, 8 Tab, 5 Ref.

Descriptors: *Electrophoresis, *Electro-osmosis, *Mine wastes, *Dewatering, *Sludge, Water reuse, Strip mine wastes, Underflow, Densification, *Washington, *Wastewater treatment.

The Washington Irrigation and Development Company (WIDCO) operates a large, multiseamed surface mine in western Washington to supply coal for a steam-electric generating plant. The mine's preparation plant thickener typically discharges about 2,600 gpm of underflow. Disposal is unusually difficult because of the large volume, suspended particles that are extremely resistant to natural settlement, and physical properties that ghange significantly and unpredictably as mining progresses. The watery underflow is pumped into a large pond where solids settle slowly and surface water is decanted for reuse in the plant. Since startup in 1970, the pond has grown to 100 acres or more with a center depth of 110 ft. Laboratory and field test results show that coal waste sludge in the WIDCO impoundment can be effectively consolidated by applying direct current between floating and buried electrodes. Treatment develops clear surface water for decanting, while 75 to 80% of the residue gradually densifies into a firm claylike product. The process becomes economically feasible when power is applied with low current density (5 to 6 ma/sq ft) and a potential of 25 v or less. Test results projected in an operational system for the WIDCO pond include a 21-acre surface electrode, submerged iron anodes, and a 12,000-amp dc power supply. Treatment would be continuously applied for 2 to 3 years. (Moore-SRC)
W82-06960

DECONTAMINATION OF OVERLAND RUNOFF FROM POPULATED AREAS,
Ministry of Reclamation and Water Management, Moscow (USSR).
Y. P. Belichencko.
Water Resources, Vol 8, No 4, p 415-149, July/August, 1981. 11 Ref. Translated from Vodnye Resursy, No 4, p 126-131, July/August, 1981.

Descriptors: *Storm wastewater, *Urban runoff, *Combined sewers, Storm sewers, Storm runoff, Storm water, Overland flow, Sewer systems, Water quality, Snowmelt, Runoff, Rainfall-runoff relationships, Water treatment, *Wastewater treatment, *USSR.

Storm water runoff from urban areas contains a variety of organic and inorganic pollutants: BOD, 12.5-145 mg per liter; suspended solids, 450-5000 mg per liter; petroleum products; asphalt, 50 g per 1 sq m paving; tire material; rubbish; leaves; and dust. Pollutant concentrations are highest at the beginning of a rain storm and at the start of the warm period in April. Snowmelt water generally has higher pollutant levels and greater variation in quality than rain water. Factors controlling the pollution levels in storm water runoff are type and condition of paving, street cleaning regime, traffic intensity, population density, and industrial activity. Treatment systems presently available are: combined sewers, separate sewer systems (industrial-domestic wastewaters delivered to treatment plants and storm water delivered untreated to the nearest surface water), and semiseparate sewers. In the semiseparate sewers all industrial-domestic wastewaters are delivered for treatment. Only the more polluted storm waters are routed to the treatment plant. This includes street washing water, rainfall from low-intensity storms, and melt waters. The nearly unpolluted runoff from heavy rainfall may be discharged into surface waters without treatment. Storage of storm waters in ponds or tanks for later treatment is advantageous because it evens the load on the treatment plant. (Cassar-FRC)
W82-06980

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,
Scientific Research Inst. of Plastics, (USSR).
N. E. Kozhevnikova, and K. M. Saldadze.
Water Resources, Vol 8, No 4, p 436-443, July/August, 1981. 4 Tab, 36 Ref. Translated from Vodnye Resursy, No 4, p 153-160, July/August, 1981.

Descriptors: *Desalination, *Membrane processes, *Reverse osmosis, *Ultrafiltration, *USSR, Industrial wastewater, Brackish water, *Wastewater treatment, Water treatment, Reviews, Electrodialysis, Separation techniques, Demineralization, Saline water, Seawater.

Membrane methods (electrodialysis, reverse osmosis, and ultrafiltration) for wastewater treatment, desalination, and water treatment are reviewed. These processes have been used widely in the U.S. since 1967. In the USSR pilot plants are being set up for cellulose acetate reverse osmosis and ultrafiltration. Single stage plants can be used for mildly saline waters, but multistage plants are necessary for highly concentrated solutions and seawater. The problem of disposing of the concentrated wastes produced by inland desalting plants can be handled by recovering waste materials for resale. An economic analysis shows that water with < 2 g per liter salt is processed more economically by ion exchange; 3-8 g per liter by reverse osmosis; and > 20 g per liter by reverse osmosis and distillation. Tables list data for five U.S. plants desalting water by the reverse osmosis method and possibilities for extracting byproducts from industrial wastewaters by membrane processes. Several examples of treating chemical and industrial wastewaters are discussed. (Cassar-FRC)
W82-06988

PROSPECTS OF USING MAGNETIC WASTEWATER TREATMENT,
Gosudarstvennyi Nauchno-Issledovatelskii Inst. Gornokhimicheskogo Syrya, Lyubertsii (USSR).
V. I. Klassen.
Water Resources, Vol 8, No 4, p 431-436, July/August, 1981. 1 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No 4, p 146-151, July/August, 1981.

Descriptors: *Magnetic wastewater treatment, *Water properties, *Wastewater treatment, *USSR, Industrial wastewater, Municipal wastewater, Chemical wastewater, Reviews, Activated sludge process, Biological treatment, Parasites, Light extinction, Suspended solids, Coagulation, Organic compounds.

Developments in magnetic wastewater treatment in the Soviet Union are reviewed. This technique is currently in use for controlling boiler scale and treating industrial and natural waters. Important factors to consider are magnetic field strength, its gradient, its frequency, velocity of the water, and pressure drop in the interpolar space. Subjecting water containing impurities to magnetic treatment changes many of its properties temporarily, for hours or days. Among the changes are an increase of light extinction, a decrease in the stability of diamagnetic ions such as Mg and Ca, changes in infrared spectra, and a 2-4-fold increase in cohesive forces on particles in a suspension. The apparatus for magnetic wastewater treatment consists of several pairs of magnets, either permanent or electromagnetic, between the poles of which the water flows at a velocity of 1-2 m per sec. Those being manufactured at present have a maximum capacity of 25 cu m per hour. Magnetic treatment has produced good results when used alone or in combination with other treatment techniques. Examples of these applications are treatment of wastewater containing suspended solids, organochlorine manufacturing wastewater, industrial wastewater containing nonferrous metals such as Zn, iron-containing acid solutions, copper ore flotation recycling water, livestock wastewater, and municipal wastewater., In chemical and industrial wastewater, magnetic treatment enhances the removal of organic impurities by the activated sludge process. 100% of helminth eggs were killed during a magnetic treatment of a pig farm wastewater with a field strength of 300-500 Oe and frequency of 8-16 Hz with the addition of 50 mg per liter ferromagnetic powder. (Cassar-FRC)
W82-06989

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,
Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 5G.
W82-06992

THE ELECTROLYTIC PROCESS FOR CHROMATE REMOVAL IN COOLING TOWERS,
First Chemical Corp., Pascagoula, MS.
T. T. Taylor.
Chemical Engineering Progress, Vol 78, No 6, p 70-72, June, 1982. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Cooling water, *Wastewater treatment, *Separation techniques, *Chromium, *Electrolysis, Industrial water, Water cooling, Cooling towers, Heavy metals, Electrodes, Corrosion control, Drinking water, Standards.

Since blowdown water from cooling towers contains all the constituents that are in the cooling tower water itself, it must be processed before discharge so that it meets environmental standards. Chromate, a corrosion inhibitor in cooling water, is limited to a maximum level of 0.05 ppm as hexavalent chromium in drinking water. To remove chromate from cooling tower blowdown, an efficient electrolytic metal removal process is recommended. This electrochemical process consists of sacrificial iron electrodes that have direct current applied to the anodes and cathodes to produce ferrous hydroxide. Chromate is then reduced from the hexavalent state to the insoluble trivalent form by the ferrous hydroxides. The electrolytic method has consistently removed chromate to less than 0.05 ppm chromium at an estimated operating cost of $0.13/cu m of cooling tower blowdown treated. (Geiger-FRC)
W82-06996

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,
Battelle Columbus Lab., OH.
J. H. Litchfield.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 688-692, June, 1982. 1 Tab, 65 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Meat-processing industry, *Wastewater treatment, *Industrial wastewater, Poultry, Fish, Activated sludge process, Biological treatment, Aminodan process. Ultrafiltration, Flotation, Coagulation, Reviews, Anaerobic digestion, Biodegradation, Aerobic conditions.

Recent developments in handling meat-, fish-, and poultry-processing wastes were discussed in reviews and in individual papers. Fats and proteins

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were the major contributors to COD. Some treatment techniques for meat-processing wastes included physicochemical processes, anaerobic filtration, activated sludge with mechanical aeration, coagulation with ferric sulfate-magnesium chloride-aluminum sulfate, cellulose activated with inorganic salts, lignite treated with sulfuric acid, a modular waste treatment plant featuring flocculation with anionic and cationic polymers and filtration through fiberglass cartridges, activated carbon adsorption, membrane processes, lagoons, flotation, electrocoagulation, sulfide liquor as a coagulant, calcium carbonate or calcium peroxide, anaerobic systems, the Aminodan process, sedimentation, heating followed by centrifugation, ultrafiltration, and combinations of the preceeding. Fish and seafood wastes were treated with fish scale coagulant, ultrafiltration, an anaerobic-aerobic shipboard system, electroflotation/electrocoagulation, coagulation, pressure flotation and separation of protein at the isoelectric point, aeration with a rotating disk, activated sludge process, activated sludge-activated carbon, and dissolved air flotation. Plant and pilot scale studies of poultry- and egg-processing wastewater treatment were summarized in a table. All of the following treatment processes were 90% effective in removing BOD, COD, suspended solids, ammonia, and phosphate: dissolved air flotation with counter-current aeration; activated sludge with 6-hour detection time; equalization dissolved air flotation with draft tube oxidation channel, clarifiers, facultative and polishing lagoons, and chlorination; and aerobic reaction for 8 days plus anaerobic digestion for 18 days. Other techniques included lime-polymer conditioning and solvent extraction. (Cassar-FRC)
W82-07000

5E. Ultimate Disposal Of Wastes

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-05904

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
For primary bibliographic entry see Field 5B.
W82-05946

SLUDGE MANAGEMENT: A RESEARCH UPDATE,
Duke Univ., Durham, NC.
P. A. Vesilind.
BioCycle, Vol 23, No 2, p 39-41, March/April, 1982. 28 Ref.

Descriptors: *Sludge digestion, *Sludge disposal, Wastewater treatment, Sludge filters, Sludge thickening, Pathogens, Composting, Dewatering, Reviews, Mixing.

Sludge management was the subject of reports, booklets, and about 20 journal articles during 1981. A mathematical model for regional management of sludge handling facilitates evaluation of alternate treatment and disposal options. Studies on head losses in sludg pipelines led to conclusions that the pipelines should be designed for turbulent flow and a safety factor of 50%. A procedure for calculating the movement of sludge by rakes was developed. A survey of thickening practices in Great Britain produced some conclusions helpful in designing thickeners. In the field of dewatering, belt filters and centrifuges were compared in 3 full-scale studies with mixed results. Low speed dewatering centrifuges performed as well as high-speed machines and used less power. Plugging of filter fabrics followed a first-order relationship. Two methods of determining the maturity of compost were phytotoxicity to bean seeds and rate of oxygen use. Indicator viruses were used to study the fate of viruses in wastewater treatment. Some areas ripe for more research are sludge decomposition nd mixing in anaerobic digesters. (Cassar-FRC)
W82-06007

LAND TREATMENT OF INDUSTRIAL WASTES: PRINCIPLES AND PRACTICES. PART II,
Science and Education Administration, Beltsville, MD.
G. B. Willson, J. F. Parr, J. M. Taylor, and L. J. Sikora.
BioCycle, Vol 23, No 2, p 59-61, March/April, 1982. 1 Fig, 7 Ref.

Descriptors: *Land application, *Chemical wastes, *Composting, Waste disposal, Degradation, Sludge disposal, Aeration.

Land application of chemical wastes is a viable treatment alternative if the physical, chemical, and biological limits of the soil are respected. Composting of industrial wastes or composting with sewage sludges may minimize toxicity to soil microflora and damage to the environment when the wastes are applied to the soil. Another approach to land treatment is preconditioning a site with sewage sludge prior to direct application of chemical wastes. Several insecticides, but not DDT, degraded rapidly when composted with cannery wastes. Composting petroleum refinery sludges reduced grease and oil significantly. Guidelines for preventing contamination of surface and groundwaters at land treatment sites were suggested in the May 19, 1980, Federal Register. Runoff and soil erosion should be minimized, and groundwater quality should be monitored before, during and after application. (Cassar-FRC)
W82-06009

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W82-06038

A COST-EFFECTIVE SYSTEM FOR THE AEROBIC STABILIZATION AND DISPOSAL OF WASTE ACTIVATED SLUDGE SOLIDS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 5, p 535-542, May, 1982. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Sludge disposal, *Construction costs, *Aerobic treatment, Sludge lagoons, Sludge solids, Lagoons, Stabilization lagoons, Design criteria, Land disposal, *Activated sludge, Kinetics, Costs, Sludge thickening.

Construction costs, power usage, and operating features of five types of aerobic stabilization systems were compared. Using the continuous post-thickening system as 1.00, the pre-thickening single cell system had a ratio of 0.99; pre-thickenig with five-cell system with or without variable retention time, 0.78; and semi-batch system, 1.90 for the pre-thickening single cell system, and 0.72 for the pre-thickening five-cell system with variable retention time. Kinetic data for the aerobic stabilization of waste activated sludge solids were reviewed and evaluated. Guidelines are given for the design and operation of three systems: a multicellular aerobic stabilizer, a 12 months stabilized solids storage lagoon, and a dedicated land disposal activity. (Cassar-FRC)
W82-06046

SLUDGE TANKERING ECONOMICS - A FRESH APPROACH,
Severn Trent Water Authority, Birmingham (England).
C. E. Brade, and J. M. Harwood.
Effluent and Water Treatment Journal, Vol 22, No 3, p 111, 114, 115-121, March, 1982. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Sludge disposal, *Solid waste disposal, *Economic aspects, Sludge thickening, Waste disposal, Waste load, Land disposal, Costs, Cost analysis, Sludge solids, Sludge utilization, England.

In 1975, 68% of all sludge in the United Kingdom was disposed to land. When hauling sludge by tankers, 2,000 gallon tankers are more economical for short hauls (less than 10 miles round trip) than larger tankers. The 3,000 gallon tanker is more economical for longer hauls. The 3,000 gallon take offers better off-the-road performance than the 2,000 gallon tanker and is less sensitive ot increases in labor costs. It is best to operate the tanker fleet for the longest possible working day, even if overtime wages must be paid. Fuel is a small factor in the overall cost of tankering sludge on the round-trip journeys common to water authority work. Money may be saved by reducing the load, fill and empty cycle time and increasing sludge thickness as much as possible. (Geiger-FRC)
W82-06076

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Washington, DC.
For primary bibliographic entry see Field 6G.
W82-06087

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,
Riyadh University (Saudi Arabia). Coll. of Agriculture.
M. El-Nennah, T. El-Kobbia, A. Shehata, and I. El-Gamal.
Plant and Soil, Vol 65, No 2, p 289-292, 1982. 4 Tab, 17 Ref.

Descriptors: *Irrigation, *Wastewater disposal, Heavy metals, Chemical composition, Soil-water-plant relationships, Public health, Cairo, *Egypt, Contamination.

This paper investigates the levels of specific nutrients and heavy metals in soils as influenced by sewage effluent deposition for various lengths of time. Surface and subsoil samples were taken from areas cultivated with citrus trees. Four of the sampling sites were from two farms irrigated with sewage effluents for 23 and 47 years. The control area samples were irrigated with artesian water. Using sewage effluents in irrigation year after year was shown to increase the available phosphorus and both total and soluble nitrogen in the soil. Surface layers generally contained higher amounts of elements than the subsurface ones. The same results were noted for water soluble boron and total and extractable heavy metals. Cairo sewage effluents were seen to contain higher accumulations of soluble salts, boron, and heavy metals than the tap water in the city, due to pollution of wastewater with industrial wastes and household laundry chemicals. It is concluded that the use of Cairo sewage effluents for crop irrigation has increased the levels of water soluble boron and heavy metals in the loamy sand soil. The increase of heavy metals and their subsequent uptake by plants should be considered a potential problem. (Baker-FRC)
W82-06228

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,
Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.

For primary bibliographic entry see Field 5B.
W82-06232

DISCHARGE TO THE NORTH SEA,
Tayside Regional Council (England).
A. Cockburn.
Water/Engineering and Management, Vol 129, No 5, p 30-32, May, 1982.

Descriptors: *Outfall sewers, *Wastewater disposal, Wastewater outfall, Outfall, *North Sea, Wastewater dilution, Wastewater treatment, Wastewater management, Municipal wastewater, *Scotland, Arbroath, Industrial wastes, Construction, Pipelines.

Arbroath, with a population of 21,000, lies on the North Sea coast of Scotland, 10 miles from the estuarine mouth of the River Tay. Arbroath is an important engineering center with other industries as well, including textiles, fishing, fish-processing and leisure industries. Wastewater treatment problems in the last decade have caused a ban on new building. Hydrographic and geophysical survey work was begun in 1976 with a view to building a long sea outfall. It was recommended that an overall length of about 3,100 feet would be needed, extending some 650 foot section of diffusers. An ultimate discharge flow of just under 350 gal/sec was decided upon. Protective treatment to the pipe was important due to the effects of heavy seas, tidal movements and the corrosive nature of sea water. Internal corrosion protection was achieved through a factory-applied isocyanate-cured coal tar epoxy resin with a minimum dry film thickness of 500 micrometers. External protection was accomplished with a quarter-inch thick bitumen enamel wrap, incorporating glass fiber fabric. This long sea outfall contract is the penultimate phase of the project which will bring about satisfactory sea disposal of much of Arbroath's sewage. Final phase of the project is construction of a pumping station and pretreatment facilities for screening and grit removal prior to discharge by the sea outfall. (Baker-FRC)
W82-06248

DISPOSAL OF SEWAGE SLUDGE TO SEA--ENGINEERING ASPECTS,
Strathclyde Regional Council, Glasgow (Scotland).
W. T. Greer.
Water Science and Technology, Vol 14, No 3, p 9-15, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Ships, Ozonation, Odor control, Activated carbon, Scotland, North Sea, Firth of Clyde.

In Scotland sewage sludge ocean dumping sites have been selected for economic, political, and environmental reasons rather than engineering considerations. Since 1974 all disposal sites must be approved by appropriate governmental departments. Shore facilities specific to sludge dumping include elevated sludge storage tanks for loading within a 1.5 hour period, sufficient pumping capacity, and loading pipes which adjust to the changes in level as the ship rises and falls with filling and the tides. Odor has been controlled by scrubbing foul air with ozone enriched water or treating with activated carbon. Sludge ships are modified tanker ships. The sludge load can be discharged by gravity within 15 min by incorporating large buoyancy spaces beneath the sludge tanks, placing the level of the top of the sludge above sea lovel. Newer ships discharge sludge by air pressure. As the lighter-than-water sludge enters the sea, it is dispersed by the ship's propellers to a 200-400 fold dilution, leaving a slick which is quickly broken up by wave action. (Cassar-FRC)
W82-06286

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W82-06287

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5B.
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,
Camp, Dresser and McKee Inc., Boston, MA.
J. A. French.
Water Science and Technology, Vol 14, No 3, p 25-31, 1982. 5 Fig, 4 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Sedimentation, Turbulent flow, Suspended sediments, Advection, Particulate matter, Settling velocity.

The particles from sewage sludge dumped into the ocean move downward and laterally, depending on particle density and ocean currents. Classical stream sedimentation analysis is used to describe three types of particle settling: unaffected by turbulence, influenced by turbulence, and dominated by turbulence. Equations are given for predicting the particles' trajectories, which are curved. (Cassar-FRC)
W82-06289

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,
Coastal Water Research Project, Long Beach, CA.
For primary bibliographic entry see Field 5C.
W82-06290

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,
Thames Water Authority, London (England).
A. G. Cockburn.
Water Science and Technology, Vol 14, No 3, p 17-24, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Water quality standards, Regulations, Legislation, Monitoring, Water quality control, International agreements, Industrial wastewater, United Kingdom.

Technical control of sludge disposal at sea is carried out to protect the environment from toxic substances and excessive concentrations of organic matter. Control is exercised by legislation and international agreements. In England control is carried out by the disposer (a regional water authority), the licensing authority (Ministry of Agriculture, Fisheries and Food), and industry. The sludge must meet quality and quantity standards. If not, appropriate treatment or process changes are required. At all stages scientific methods are used to monitor sludge composition, water quality, and environmental changes. (Cassar-FRC)
W82-06291

SLUDGE DISPOSAL TO SEA IN U.K.,
Thames Water Authority, London (England).
L. H. Thompson.
Water Science and Technology, Vol 14, No 3, p 79-91, 1982. 2 Fig, 5 Tab, 10 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *United Kingdom, Thames Estuary, Ships.

Sludge disposal in the sea in the United Kingdom is summarized. Currently 12 water authorities (31 sewage works) dispose of sludge by dumping or pipeline. The three largest activities--London, Manchester, and Glasgow--have been operating for 80 or more years. A map depicts the origin of the sludge and the dumping grounds as well as populations and amounts of sludge produced. The Thames Estuary dumping operation is described in detail, and ten other operations are summarized. Ocean dumping of sludge has increased in the United Kingdom during the last two decades, contrary to the trends in the U.S. and Europe. The United Kingdom's strategy for the future is to incinerate heavily industrialized and special sludges, digest sludges, store and thicken sludges prior to land or sea disposal, ensure that sludge quality is suitable for disposal, choose sludge disposal sites according to economics with preference to land application in marginal cases, and consider each case individually. (Cassar-FRC)
W82-06292

DISPOSAL OF SEWAGE SLUDGE TO SEA--RESEARCH NEEDS,
Water Research Center, Stevenage (England).
A. R. Agg.
Water Science and Technology, Vol 14, No 3, p 71-77, 1982. 1 Tab, 12 Ref.

Descriptors: *Research priorities, *Ocean dumping, *Sludge disposal, Fate of pollutants, Nutrients, Particulate matter, Water pollution effects, Degradation, Organic compounds, Algae, Heavy metals, Sedimentation.

The need for further research on the environmental effects of ocean dumping of sewage sludge is discussed with reference to the United Kingdom. Major effort should be directed toward determining the assimilative capacity at selected sites and the effects of improving sludge quality on the quantity of sludge which can be disposed of. Special topics for which further information is needed are: (1) determination of relative inputs of potential contamination from all land-based sources, (2) physical processes controlling dispersion, sedimentation, and degradation of sludge solids, (3) mechanisms which control mobilization and transfer of metals and organic chemicals from sludge, and (4) the role of nutrients and other sludge components in development of certain algal blooms. (Cassar-FRC)
W82-06293

SELECTION OF A SLUDGE HANDLING DISPOSAL SYSTEM,
Malcolm Pirnie, Inc., Paramus, NJ.
A. F. Hess, and M. J. Barnes.
In: Water/Engineering and Management, Reference Handbook-1982, p 61-64, 66-67, May, 1982. 2 Fig, 40 Ref.

Descriptors: *Sludge disposal, *Design criteria, Wastewater treatment, Water treatment facilities, Coagulants, Filtration, Sludge dewatering, Lagoons.

The problem and expense of ultimate disposal of water treatment plant sludge are discussed. Estimating the quantity of solids produced at a water treatment plant is the first step involved in the selection and sizing of a sludge handling and disposal facility. The solids load is a function of the raw water suspended solids and color, the dosage and type of chemicals used in the treatment process and the quantity of water treated at the plant. Waste volumes are dependent on the solids loads and the estimated solids concentration of the sludge. The quantity and characteristics of sludge produced during water treatment is affected significantly by the design and performance of the treatment processes, especially rapid and slow mixing, points of chemical addition and short circuiting. The principal methods for reducing sludge quantities are source control, coagulant conservation, coagulant substitution, coagulant aids, process optimization, process modifications, coagulant recovery, and direct filtration. Various dewatering systems have been tested on all types of water treatment plant sludges. Feasible alternatives for dewatering sludge include: sand drying beds, lagoon, vacuum filtration, pressure filtration, centrifugation, belt filtration, and recalcination. Ultimate disposal of sludge from a water treatment plant is primarily dependent on the characteristics of the processed and dewatered sludge, especially the water content of the sludge cake. Based on the characteristics of dewatered sludge potential methods include contract or joint disposal, landfilling, use as cover material at landfill or strip mine, use as a soil conditioner, and conversion to a usable or salable product. (Baker-FRC)
W82-06346

LIBRARY U. OF I., URBANA-CHAMPAIGN

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W82-06347

A LOOK AT CO-DISPOSAL,
Temple Univ., Philadelphia, PA. Coll. of Engineering Technology.
B. P. Butz, and L. B. Calhoun.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EY2, p 79-90, June, 1982. 11 Ref.

Descriptors: *Waste disposal, *Incineration, *Sludge disposal, Sludge, Solid wastes, Wastewater treatment, Municipal wastes, *Co-disposal, Recycling, Energy conservation, Financing, Performance evaluation.

One alternative that a municipality might consider for the disposal of solid waste and sludge is combined disposal, or co-disposal. Resource and energy recovery systems are often incorporated in co-disposal designs, which are considered innovative in the United States. Thermal co-disposal in either solid waste or sludge burning equipment has been shown to be feasible technologically. Co-incineration in solid waste burning incinerators is the best developed and proven co-disposal technology. Pyrolysis is a high risk technology. These plants are generally complex, expensive, and subject to breakdowns. The benefits of resource recovery techniques seem to be overvalued. The poor track record of co-disposal plants presents potential investors with a theoretically promising technology, but one that has high risk. Unless this risk can be minimized, co-disposal projects will have a difficult time securing financing. The environmental impact of a particular co-disposal plant will depend on the particular process selected and the characteristics of the geographical area in which the plant will be located. Insufficient data exist to quantify the adverse environmental impacts. Some impacts, such as those on water quality, should be no greater than for separate incineration of sludge and solid waste. (Baker-FRC)
W82-06354

LAND DISPOSAL OF SEWAGE SLUDGE, A SUMMARY OF RESEARCH RESULTS, 1972-1980,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
Y. K. Soon, and T. E. Bates.
Ontario Ministry of the Environment, Toronto, Report, 1981. 167 p, 15 Fig, 103 Tab, 26 Ref.

Descriptors: *Land disposal, *Wastewater, *Sludge disposal, *Application rates, *Wastewater farming, Wastewater treatment, Wastewater disposal, Soil disposal fields, Broad irrigation, Phosphorus removal, Chemical treatment, Digested sludge, Fertilizers, Greenhouses, Crop yield, Crop production, Soil organic matter, Coliforms.

Land application of fluid sewage sludge from chemical treatment for phosphorus removal was studied to determine safe rates of sludge application to agricultural soils without polluting ground/surface waters with elements/bacteria harmful to humans/animals or without reducing the quantity/quality of the crops produced. The various study phases involved: runoff assessment with fall/winter/spring-applied sewage sludge; rate and source of sludge field studies with corn and bromegrass; nitrogen studies; microbial studies; pedological study and characterization of sludge-treated soils; a greenhouse study on metal uptake with sludges; and a greenhouse and laboratory study to select a chemical extractant for plant-available heavy metals in polluted soils. Runoff losses of nutrients/metals can be acceptable provided the sludges are applied at less than 1.5 cm/application, are applied at least 48 hours before predicted heavy rains, and are not applied to steep slopes, near waterways, or to ice/snow/frozen soils. Low sludge rate applications produced corn/bromegrass yields as high as ammonium nitrate plus phosphate fertilizers. While fluid-digested sludges contained co nsiderable total and fecal coliforms and streptococci, its application to crop land did not result in a greatly-increased level of these microorganisms in runoff waters. Multiple regression analysis of 9 extractants tested showed diethylenetriamine pentaacetic acid as the most suitable for cadmium, nickel, and zinc. (Zielinski-MAXIMA)
W82-06377

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,
Argonne National Lab., IL.
S. W. Ballou, L. Dale, R. Johnson, W. Chambers, and H. Mittelhauser.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0107, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV-0107, September 1980. 44 p, 5 Fig, 30 Tab, 21 Ref.

Descriptors: *Feedlot wastes, *Sludge, *Anaerobic digestion, *Manure, *Energy conversion, *Incineration, Cost analysis, Biological treatment, Fuel, Treatment facilities, Pyrolysis, Water pollution, Air pollution, Environmental effects.

Literature on waste processing and energy conversion, and interviews with manufacturers was used for baseline data for construction of theoretical models using three energy conversion processes: anaerobic digestion, incineration, and pyrolysis. Anaerobic digestion of municipal sludge can be used to recover energy from sludge while simultaneously destroying pathogenic organisms and odors associated with the sludge. Digester gas can be used as fuel at the wastewater treatment plant that produces the sludge feed to the digester. Anaerobic digestion of manure yields gas with a heating value of 600 Btu/cu ft. Digested manure is considered a good source of animal feed, in addition to its utility as fertilizer. Recovery of energy by sludge incineration involves raising steam by cooling the hot flue gases. The steam may be used for heating but the most attractive possibility is to use steam turbines to drive motors directly or to produce electricity for the same use, in an associated wastewater treatment plant. Pyrolysis is a potentially efficient method for recovering energy from sewage sludge: the products can provide a significant portion of the energy required by municipal wastewater treatment plants. For manure, energy production by pyrolysis is assumed to occur near markets for the recovered energy. Although the systems would provide benefits in terms of waste disposal as well as energy production, they would also involve additional pollution of air and water. (Moore-SRC)
W82-06405

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,
Camden County Municipal Utilities Authority, NJ.
For primary bibliographic entry see Field 5D.
W82-06461

RECOVERY OF ZINC FROM WASTEWATER TREATMENT SLUDGE,
Bureau of Mines, Rolla, MO. Rolla Research Center.
J. B. Stephenson, E. R. Cole, and D. L. Paulson.
Resources and Conservation, Vol 6, No 3/4, p 203-210, 1981. 6 Tab, 5 Ref.

Descriptors: *Zinc, *Metal-finishing wastes, *Sludge treatment, *Wastewater treatment, Industrial wastes, Electroplating.

Zinc was recovered from metal finishing wastewater treatment sludge by a process using roasting, leaching-purification, and electrowinning. The sludge, containing metal hydroxides, oil, organics, and water, was roasted at 600-800 C to avoid excessive Zn volatilization. The roasted filter cake contained 31.1% Zn, 2.9% Pb, 1.5% Sn, and 1% or less of Cu, Fe, C, and Ni. Leaching with dilute sulfuric acid for 2 hours at 348 K at a solids concentration of 300 g per liter produced a liquor containing (in g per liter); Zn, 154; Cu, 3.0; Ni, 0.6; and Fe, 0.2; with a pH of 1.9. About 90% of the Zn was extracted. The high concentration of Ni and other interfering impurities required modification of the standard purification process. Iron was removed with potassium permanganate. Zn dust purification did not reduce the Ni lvel to the desired 0.1 ppm. A second Zn dust treatment produced a filtrate satisfactory for electrowinning. The electrolyte was mixed with water and sulfuric acid. Lead dioxide-coated Ti anodes were used with 1100 alloy Al cathodes to electrowin the Zn at 560 A per sq m and 308 K. Deposit morphology was fairly good, but current efficiency was about 76%. (Cassar-FRC)
W82-06485

POTATO AND CORN BY-PRODUCTS USED AS CATTLE FEED,
Frito-Lay, Inc., Dallas, TX.
J. L. Revel.
Industrial Wastes, Vol 28, No 3, p 27-31, May/June, 1982. 3 Tab.

Descriptors: *Sludge disposal, *Food-processing wastes, *Waste recovery, *Feeds, Food processing industry, Industrial wastes, Cattle, Waste management, Recycling, Solid waste disposal, Land disposal, Cost analysis.

Frito-Lay, a division of PepsiCo Incorporated, has maintained primary and secondary wastewater treatment facilities for its potato and corn snack manufacturing plants for several years. The company faced sludge disposal problems and began to examine wet sale markets for by-products, sludge-by-product mixtures, and secondary treatment biosolids. Wet sale of potato and corn wastes can be profitable if shipping costs to buyers, mainly cattle raisers, can be kept down. Frito-Lay currently operates three plants with an installed potato starch recovery module. Secondary biosolids are being disposed of mainly via land application and municipal digesters. Frito-Lay is studying the feasibility of using biosolids as an animal feed ingredient. Procedures for registering animal feed by-products are explained. Efforts must be made to prevent contamination of by-products with substances which may be injurious to animal health. Hauling of commodities is regulated by various state and federal agencies and should include a contract for services to establish legal responsibilities. A back-up system for disposal is recommended. Frito-Lay has planned feed trials with dairy and beef cattle to increase acceptance of this cost-effective disposal method. (Geiger-FRC)
W82-06488

FEED FROM SEWAGE: PROSPECTS AND CONSTRAINTS,
New Mexico State Univ., Las Cruces. Dept. of Animal, Range and Wildlife Sciences.
G. S. Smith.
Biocycle, Vol 23, No 3, p 34-36, May/June, 1982. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Waste disposal, *Feeds, *Sewage, *Livestock, Cattle, Sheep, Feedlots, Reviews, Sludge disposal, Heavy metals, Adsorption, Cadmium, Nutrient requirements, Nutrients, Nutrition, Diets, Animal populations, *Recycling, *New Mexico, Las Cruces, Albuquerque.

For the past six years New Mexico State University (NMSU) has been conducting extensive research on the feasibility of recycling sewage products as livestock feedstuffs. Sewage solids used in the NMSU research were collected as primary settled solids at treatment plants of Albuquerque and Las Cruces, NM, both of which have minor inflows from industry and low levels of cadmium. Sludges were dried, bagged, sealed and gamma-irradiated to an absorbed dosage of 1 mega-rad using cesium-137. In most of the studies conducted with ruminants, the digestibility of the energy content in sewage products was about 60%, digestibility of nitrogen was about 70%, and retention of absorbed nitrogen was about 60-70%. Experimental supplements containing one-half or more of the dry matter as dried, irradiated sewage solids were

fed to cows on arid range during three or four months each year for over four years. Improved performance was recorded compared to unsupplemented diets. Two feedlot trials were conducted with cattle fed sewage solids as 12 to 15% of diet for two or three months to measure uptake of heavy metals and halogenated hydrocarbons into organs and tissues. A bioassay of meat quality was performed as a multi-generation feeding trial with albino rats. Overall the data suggest that dried sewage solids from primary sludge can be sterilized and substituted for conventional, higher-priced feeds for ruminants without adverse effects on reproductive or feedlot performance. Feeding dried gamma-irradiated sewage solids to ruminants produced no evidence of animal toxicity nor a hazard to human health during six years of study. (Baker-FRC)
W82-06489

OCEAN DUMPING BATTLE MARCHES ON,
N. Goldstein.
Biocycle, Vol 23, No 3, p 27-31, May/June, 1982. 2 Fig.

Descriptors: *Sludge disposal, *Ocean dumping, Waste disposal, Sludge, Wastewater management, Legislation.

A study by the National Advisory Committee on Oceans and Atmosphere was released in January of 1981 which stated that the role of the oceans is a positive one in waste management strategy, and that the ocean has the ability to assimilate waste products. Ocean disposal of sewage sludge was encouraged in the report as an option in areas where no unreasonable degradation of the environment would result. Appropriate management conditions and adequate monitoring safeguards were considered essential. This finding enabled New York City to file suite against the EPA for refusing to grant an extension to the city's interim ocean dumping permit. The House Oceanography, Fisheries and Wildlife Conservation, and Environmental Subcommittees have endeavored to present amendments which would close the loophole through which New York City had passed. Joint hearings on the draft legislation were held in Washington in late March 1982. The amendments offered to the Marine Protection, Research and Sanctuaries Act were starting point for clearing up some of the ambiguities of the present Ocean Dumping Act; a second draft was proposed in late April. The basic thrust of the bill/amendments is to allow EPA some leeway in reviewing ocean dumping application permits. If a sludge is deemed suitable for ocean dumping, the bill is set up to give the EPA administrator a chance for a second test to determine if the sludge is clean enough to be applied to land. (Baker-FRC)
W82-06490

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,
CH2M/Hill, Redding, CA.
For primary bibliographic entry see Field 3C.
W82-06507

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5B.
W82-06518

SELECTION OF WASTE DISPOSAL SITES,
Illinois State Geological Survey Div., Champaign.
K. Cartwright.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 197-201. 1982. 37 Ref.

Descriptors: *Waste disposal, *Site selection, *Leachates, *Fate of pollutants, Landfills, Geohydrology, Groundwater pollution, Groundwater movement, Hydraulic conductivity, Groundwater recharge.

Selection of sites for waste disposal must consider the hydrological factors of hydraulic conductivity, relationshiip to groundwater systems, and the geochemical interaction of the leachate with the media. In general, earth materials with low hydraulic conductivity (on the order of 10 to the minus 6th power cm per sec or less) reduce contaminants to acceptable levels within tens of ft from the disposal site. Any contamination is associated with springs or streams on or very near the site. If hydraulic conductivity of the earth materials is on the order of 0.01 cm per sec or greater or the rocks are fractured, contaminants at dangerous concentrations may travel for hundreds or thousands of ft. The presence of a sand layer will amplify the horizontal movement of the groundwater flow. In humid regions it is almost impossible to find a disposal site not in a groundwater recharge or discharge area. Recharge areas require more thorough investigation of the groundwater flow path because of the downward movement. In discharge areas leachate paths are generally short, near the surface, and easier to confirm. It is often practical to recover all or part of the leachate in discharge areas. Disposal below the water table may produce large volumes of leachate, odorous gases, and operational difficulties with earth moving machinery. Disposal above the water table may be difficult because low water table regions often have very permeable overlying material, unsaturated earth may transmit undesirable gases, and leachate may be difficult to collect. The hydraulic conductivity of the earth is much more important than whether a site is above or below the water table. The geochemical reactions in a waste disposal site are complex. However, in general, reactions are controlled by anion and cation exchange, buffering capacity of the soil, and dilution. (Cassar-FRC)
W82-06550

LANDSPREADING OF SLUDGE IN NEW YORK STATE,
D. A. Fagan.
Biocycle, Vol 23, No 3, p 57-61, May/June, 1982.

Descriptors: *Sludge disposal, *Land disposal, Sludge, Wastewater management, Waste disposal, Soil disposal fields, Legislation, Regulations, Legal aspects, *New York, Wastewater disposal, Wastewater treatment.

A moratorium on the landspreading of sewage sludge on certain agricultural soil types was executed in New York State in March of 1981. The purpose of the two year moratorium was to provide sufficient time for the federal government to establish a definitiv policy on the use of sewage sludge for land application purposes. Currently the Department of Environment and Conservation (DEC) in conjunction with Agriculture and Markets is completing a draft Environmental Impact Statement (EIS) on the sludge moratorium. Tentative plans called for this draft to be completed in March of 1982, with public hearings following 30 days later. Current sludge management regulations in New York are contained in two sections of the State Environmental conservation Law. In May of 1981 DEC published guidelines designed to help solid waste management applicants, including sludge landspreaders, meet the regulations so as to obtain the construction or operating permits needed. The most important aspect of the guidelines and regulations involves the requirement for permit applicants to develop a management plan including a monitoring and recordkeeping program. Compared to past landspreading practices, the major changes in the guidelines and regulations relate tothe requirements for incorporating surface applied sludge into the soil the same day it is spread, and the prohibition of surface application to frozen or snowcovered ground. The effects of these guidelines on cost of operating a land disposal system are discussed. (Baker-FRC)
W82-06557

OCEAN DUMPING OF SLUDGE VS. THE ALTERNATIVES,
Clinton-Bogert Associates, Fort Lee, NJ.
I. L. Bogert, and L. J. Sokol.
Water Science and Technology, Vol 14, No 3, p 1-8, 1982. 3 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, Water pollution effects, Bergen County, New Jersey, Environmental effects, Cadmium, Mercury, Polychlorinated biphenyls, DDT, Heavy metals, Landfills, Incineration, Fish, Aquatic life, Bioaccumulation, Regulations.

The environmental effects of ocean dumping of sludge and land-based disposal alternatives were evaluated using Bergen County, New Jersey, digested sludge. Problems with land disposal include airborne Aspergillus fumigatus spores emanating from the composting site and high heavy metal concentrations in the sludge. Bergen County digested sludge contained (in micrograms per liter liquid phase): Hg, 45.2; Cd, 330; polychlorinated biphenyls, 4.4; and DDT, < 0.05. If this sludge is discharged in the ocean at the permitted barge speed and discharge rate, dilution is 5200:1, producing diluted concentrations of less than the water quality criteria. Bioassays of the suspended particulate phase of the sludge indicated that the LC50 in the worst case was 150:1 dilution of sea water: sludge or 6700 mg per liter. Ten days of exposure of grass shrimp, hard clams, and Atlantic silversides to the suspended particulate phase (containing Cd, Hg, PCB, and petroleum hydrocarbons) indicated no statistical difference in bioaccumulation as compared with controls. The authors conclude that ocean dumping is less environmentally damaging than land disposal and that the site 12 miles from shore in the New York Bight should not be abandoned for a proposed 106 mile distant site. (Cassar-FRC)
W82-06590

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,
Thames Water Authority, London (London).
J. L. Dakers, and R. P. King.
Water Science and Technology, Vol 14, No 3, p 53-59, 1982. 2 Tab, 2 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Industrial wastewater, Fate of pollutants, Land disposal, Thames Water Authority, Mercury, Cadmium, Nickel, Zinc, *Heavy metals, Metals, Wastewater analysis, Water quality standards, *England.

Toxic heavy metals levels in sewage sludge discharged into the ocean from the Thames Water Authority plants were reduced by controlling metals levels reaching the municipal treatment plants. The high concentration of Hg in Beckton plant sludge was reduced from 19 mg per kg in 1975-76 to 14 mg per kg by limiting Hg in effluents from a single organo-mercurials manufacturing plant. Cd, Cu, Ni, and Zn in sludges from the Mogden plant, which are applied to land, were also decreased by control of metals in trade effluents. Effluents from potential metal discharges in several sewage works regions were sampled regularly for several months to a year to provide information on the total load of metals entering the sewage works and the total load contributed by industry. The difference between the two values was the amount derived from domestic sources. As an example, the data for Cd are given for several treatment plants. Existing Cd loads received at two of the works were 7.9 and 7.7 kg per day, producing sludge concentrations of 46 and 40 mg per kg, respectively. Contributions by trade effluents were 61-70%. Reducing the Cd concentrations in effluents received at the plant to 1 mg per liter would reduce the Cd in finished sludge to 32 and 16 mg per kg, respectively. Although uniform limits on metal levels are superficially attractive, flexibility in administering the guidelines is urged to prevent expensive and stringent controls in cases where these will not significantly improve the quality of the sludge. (Cassar-FRC)
W82-06592

SLUDGE DISPOSAL TO SEA IN FRANCE,
Centre d'Estudes et de Recherches de Biologie et d'Oceanographie-Medicale, Nice (France).
M. Aubert, M. J. Gauthier, and J. Aubert.
Water Science and Technology, Vol 14, No 3, p 169-182, 1982. 8 Fig, 2 Tab, 13 Ref.

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Descriptors: *Sludge disposal, *Ocean dumping, *Bacteria, Wastewater treatment, Wastewater disposal, *France, Particulate matter, Fate of pollutants, Outfalls, Suspended solids, Self purification.

A review of the nature of the polluting elements of sewage water and the interactions between bacteria and particulates in sludge is presented. A mathematical formulation of the dynamics of suspended matter in the sea is established. The initial concentration of bacteria at the point of surfacing is obtained from the concentration of bacteria in the sewage water before release, drift time, a depth of discharge coefficient, an outfall coefficient, and a coefficient for bactericidal action of sea water. Another similar equation expresses the spread of matter not subject to bactericidal action. Injecting wastewater below the thermocline reduces chances of rapid resurfacing, especially if diffusers are used. At the lower depths self-purification is not very efficient. Several types of wastewater treatment are used in France: pretreatment (removal of solids, oil, and grease--usually burned); primary treatment (carried out in lagoons or pools); and secondary or tertiary treatment (purification by chemical or biological means with sludge digestion in anaerobic digesters). The digested sludge produced by these processes is disposed of on land as fertilizer or as fill in road surfaces. Sea disposal of sludge has been tried with poor economic success at St. Tropez. The Interministerial Group for Problems of Sea Pollution in 1973 condemned the practice of coastal communities discharging untreated sewage into the sea. For financial reasons the establishment of treatment plants has been delayed. Of first concern is removal of solid matter, oil, and bacteria. (Cassar-FRC)
W82-06593

MATHEMATICAL MODEL INVESTIGATION OF FAR-FIELD TRANSPORT OF OCEAN-DUMPED SEWAGE SLUDGE RELATED TO REMOTE SENSING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. Y. Kuo.
Water Science and Technology, Vol 14, No 3, p 33-39, 1982. 2 Fig, 8 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Fate of pollutants, Model studies, Mathematical models, *Remote sensing, Diffusion coefficients, Plumes, Particle distribution, Particle size.

The far-field transport processes of sewage dumped in the New York Bight were examined by a modification of a three-dimensional Eulerian-Lagrangian finite difference model. The model provides information on the effect of the magnitude of the horizontal and vertical diffusion coefficients and the particle density and size distribution on the sludge plume as it changes with time. The sludge plume was also studied for general trends of spreading, contours of equal concentration, and maximum sludge concentration at a given time after dumping. Model inputs were velocity field, sea conditions, diffusion coefficients, sludge characteristics, and dumping rate. Both ground truth data and remote sensing data were compared with model results. Agreement on trend of plume growth was fairly good between model results and remote sensing data. Concentrations obtained from averaging over the top 2, 4, and 8 ft were significantly different. Generally, integration over the top 8 ft indicated higher concentrations than the others. (Cassar-FRC)
W82-06594

DISPOSAL OF SLUDGE TO SEA,
Oslo Commission (Norway).
H. R. Neilson.
Water Science and Technology, Vol 14, No 3, p 145-152, 1982.

Descriptors: *International agreements, *Sludge disposal, *Ocean dumping, Land disposal, Oslo Commission, Paris Commission, Helsinki Convention, Barcelona Convention, Water quality control, Legislation, Legal aspects, London Dumping Convention.

The role of international conventions in marine dumping of sludge was the subject of the introductory paper in a conference on disposal of sludge to the sea. The aim of the International Conventions (Oslo Commission on sea dumping, Paris Commission on pipeline discharges, Helsinki Convention on the Baltic, and the Barcelona Convention on the Mediterranean) is to prevent marine pollution through the coordination of the separate control measures exercised by individual countries. The conventions provide a forum for discussion and try to make decisions by mutual agreement rather than by vote. Problems facing waste disposal personnel are increasing amounts of sewage, expanding and increasingly complex industrial wastes, environmental lobbies, and the world economic recession. The international conventions can lead the effort to coordinate scientific resources to tackle recycling of sludges and long term strategies. The author suggests that regional conventions can control marine pollution better than global conventions because each region requires individual consideration. The global London Dumping Convention is the ideal body for coordination of regional conventions. In 1984 the end of the first decade of the Oslo Convention will be celebrated by publishing the achievements and results of scientific and monitoring studies. (Cassar-FRC)
W82-06595

SLUDGE DISPOSAL STRATEGY: A UK VIEWPOINT,
National Water Council, London (England).
D. L. Walker.
Water Science and Technology, Vol 14, No 3, p 127-136, 1982.

Descriptors: *Sludge disposal, *Ocean dumping, United Kingdom, Land disposal, Agriculture, Incineration, International agreements, Research priorities, Water policy.

This paper describes the world attitudes and the United Kingdom policies toward sewage sludge disposal. The Water Act of 1973, which organized 10 all-purpose water authorities in England and Wales, placed sewage disposal under the jurisdiction of the water authorities. This responsibility belongs to regional councils in Scotland and to the Department of Environment in Northern Ireland. Water authorities must dispose of sludge within legal constraints and must consider farmer's attitudes toward land disposal. The Ministry of Agriculture Fisheries and Food issues permits for sludge disposal at sea. In England and Wales the 1.2 million tons (dry weight) per year of sludge produced was disposed of in 1977 in the following ways: 48% on farm land, 24% on landfills, 24% at sea, and 4% incinerated. Methods, guidelines, hazards, safeguards, and problems associated with disposal of sludge on land, at sea, by incineration, and by other methods are described. England and Wales do not dump sludge unsuitable for land treatment into the ocean. Pretreatment is required to control levels of toxic metals or other materials. Contaminated sludge is incinerated. Water authorities favor sea disposal as an economic method for sludge disposal. Water authorities are concerned with the total load of pollutants entering waters from all sources. Restraints will not be applied to sludge disposal without also controlling discharges to rivers and tidal waters. The costs of sludge disposal represent 10% of total consumer bills. Sophisticated methods of sludge disposal can easily double disposal costs without significantly improving safeguards to the environment. The water authorities plan to retain flexibility of choice in sludge disposal options. (Cassar-FRC)
W82-06596

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
C. F. Guarino, and S. Townsend.
Water Science and Technology, Vol 14, No 3, p 153-161, 1982. 9 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Legislation, Water law, Judicial decisions, Regulations, Legal aspects, Permits, Water quality control, Water pollution effects, Heavy metals, Philadelphia, Pennsylvania, New York.

Sludge disposal legislation in the U.S. is complex and confusing. At least 12 different Federal laws govern sludge disposal. In addition, there are conflicting regulations and policies for implementing the laws. The Marine Protection Act (1972) was designed to regulate dumping into ocean waters of any material which would adversely affect humans, the marine environment, ecological systems, or economic potentials. Permits were required to regulate the amount of hazardous materials entering the ocean. Case studies of sludge disposal in two cities are given. Philadelphia, Pennsylvania, was required to end ocean dumping of sludge after issuance of an EPA report, widely criticized for its lack of objectivity and of scientific evidence of harm to the environment. As a result, ocean dumping was ended by the required deadline and land disposal was implemented at significantly greater costs. In contrast, New York was allowed to continue dumping sludge in the heavily polluted New York Bight after the December 31, 1981, deadline prescribed by the law. (Cassar-FRC)
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,
W. F. Garber.
Water Science and Technology, Vol 14, No 3, p 109-125, 1982. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Legislation, Water law, Legal aspects, Water quality standards, Waste disposal, Water pollution control, Philadelphia, Pennsylvania, Los Angeles, California, Outfalls, Environmental effects, Wastewater treatment, Wastewater disposal, Pulp wastes, Toxicity, Aquatic life, Santa Monica Bay, Heavy metals, Metals.

Sludge disposal to the sea in the United States is a subject of controversy. Laws and regulations concerning waste disposal are conflicting and make environmentally responsible solutions to problems difficult or impossible to attain. Legislation treats air, water, and land pollution separately. For example, an industry or municipality wishing to dispose of its wastes may find it prohibitory or difficult to incinerate (Clean Air Act), to dispose at sea or in inland waters (Federal Water Pollution Control Act), to dump from ocean barges (Marine Protection, Research, and Sanctuaries Act), and to dispose on land or in deep wells (Safe Drinking Water Act). Case studies of three cities are given to illustrate existing attitudes. Philadelphia, Pennsylvania, was prohibited by the EPA from dumping sewage sludge into the ocean despite lack of evidence of harm to the marine environment. Los Angeles, California's Hyperion treatment facility was allowed to continue sewage disposal through three ocean outfalls when it was shown that this disposal method was the most environmentally sound. Two paper companies discharging carbohydrate wastes deep in the ocean in an area of excellent mixing were ordered to dispose waste on land in spite of the negative environmental impact of land disposal. These cases illustrate the disadvantages of applying laws uniformly throughout the nation without considering the great differences in individual situations. Recent regulations result in standards sometimes lower than the best techniques can detect and in standards lower than concentrations in pristine water supplies. However, some trends toward more consideration of scientific evidence and evaluation of individual cases are apparent. (Cassar-FRC)
W82-06598

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,
D. C. Macleod.
Water Science and Technology, Vol 14, No 3, p 93-107, 1982. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Outfalls, *Ocean dumping, Durban, *South Africa, Heavy metals, Water quality, Bacteria, Aquatic life, Inverte-

brates, Water pollution effects, Wastewater disposal, Settleable solids, Fate of pollutants.

The performance and effects on the marine environment of two sea outfalls at Durban, South Africa, are reported. Previously published monitoring data on ocean currents, dilution, and onshore frequency are reviewed. Originally the outfalls were designed for discharge of settle effluent but during 1970-71 it was necessary to discharge raw sewage through Bluff Outfall. As of January 1978 the 1 ml per liter settleable solids limit was changed to 2 ml per liter to allow for discharge of sludge with the settle effluent. Scum, grease, and floatable objects are totally removed so that the sludge is in finely divided form. Surf zone water quality is shown on a bar graph for 26 stations and at the two outfalls for the years 1964-1981. In general, water quality at the beaches near the Southern (Umlaas) Outfall is poorest. Predominant organisms from sediment samples are nematodes, polychaetes, oligochaetes, archiannelids, and isopoda. (Cassar-FRC)
W82-06599

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,
Umweltbundesamt, Berlin (Germany, F.R.).
D. Fuchs.
Water Science and Technology, Vol 14, No 3, p 163-168, 1982. 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, *Federal Republic of Germany, Aquatic life, Fish, Hamburg, Landfills, Agriculture, Heavy metals, Metals, Land application, Industrial wastes, Permits Legislation, Water pollution effects.

In Germany land disposal of sludge is given priority over sea dumping. Only sewage sludge is dumped into the ocean. Industrial wastes are treated on land. The only city dumping sludge into the sea is Hamburg, which has disposed of 18,000 metric tons (dry weight) each year since 1962 in the North Sea)Inner German Bight). This amounts to 1% of the 1.8 million tons (dry) of sewage sludge produced in the country. The present dumping permit for Hamburg, which expires in 1983, is not expected to be renewed or extended. The dumping area is considered an endangered biological system according to scientific studies. For example, fish have suffered increased sublethal damage and disease and decreases in species numbers and richness. Heavy metals contents in sediments are suspended matter have increased, and bottom waters suffer from oxygen depletion in summer. Sludge disposal on land has been 40% for agriculture, 55% by land fill, 10% by incineration, and 5% other. (Cassar-FRC)
W82-06600

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),
Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
L. Tent.
Wasserwirtschaft, Vol 72, No 2, p 60-62, February 1982. 2 Fig, 3 Tab, 18 Ref. English Summary.

Descriptors: *Heavy metals, *Spoil banks, Agriculture, Harbors, *Dredging, Suspended solids, Cadmium, Waste disposal, Soil properties, Hydrogen ion concentration, Alkalinity, Plant growth, Estuaries, Elbe river, Rivers, Tidal rivers, Water currents, *West Germany.

Polders made up of material dredged from the harbor of Hamburg, West Germany, were tested for suitability for agricultural application. The port of Hamburg is situated in the upper limnic portion of the tidal Elbe River estuary, where the current is weak. Consequently, suspended solids transported from upriver accumulate in the harbor. Heavy metals have been found in dredged material in concentrations ranging from 7-25 mg/kg for cadmium, 250-600 mg/kg for copper, and 1500-2500 mg/kg for zinc. Cadmium levels measured in polders formed before 1970 and used for agriculture and in those formed after 1970 and not used agriculturally showed no clear reduction with time. The nutrient content of the polder soil is high and favorable to plant growth, and the high chalk content and buffer capacity mean that the soil is weakly alkaline and that the heavy metals are not taken up by plants. However, if the chalk used by plants or leached out is not replaced adequately, the pH is reduced and plants begin to absorb heavy metals. This has led to a decrease in the quality of grain produced on some polders. Research into methods of improving soil contaminated in this way, into the hydrology of polders, and into new technology for treatment and disposal of dredged material is being performed. (Gish-FRC)
W82-06637

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,
Northumbrian Water Authority (England).
J. M. Eno.
Water Pollution Control, Vol 81, No 1, p 37-44, 1982. 4 Fig, 2 Ref.

Descriptors: *Outfall sewers, *Ocean dumping, Wastewater outfall, Water pollution sources, Water pollution prevention, Wastewater treatment, Wastewater facilities, Screens, United Kingdom, Coastal waters, Performance evaluation.

There are more than 100 outfalls of various sizes discharging sewage or surface water to the sea along the Northumbrian coastline. However, only 13 of the 64 foul-sewage outfalls currently employ any form of preliminary treatment. Although the 26 district councils are responsible for the pretreatment facilities at the head of coastal outfalls from public sewerage systems, the Northumbrian Water Authority has been involved in the design and operation of these facilities since 1974. Pretreatment plant design criteria are outlined. Screens in a rotating drum configuration have been found to be the only screening devices capable of ensuring 100% compliance with maximum particle size requirements for discharges. The design configurations and process performance of four existing screening installations at ocean outfalls on the northeast coast are described. Reviews of the operation of these plants have led to several significant conclusions regarding factors affecting the process reliability of drum screening installations. The diameter of the holes forming the mesh in thin steel plates appears to be critical to continuity of process performance. These holes should be no larger than 4 millimeters in diameter. For optimal results, thicker plastic plate is preferable to thin steel plates. Techniques for the continuous cleansing of screen surfaces in both cup and drum configurations also appear to be critical to process performance. The principle of recycling generally results in more economical development and operation of screening installations at pretreatment plants on coastal outfalls as compared with batch-type operations requiring extraction, processing, and removal of screenings. Large plants are preferably to be located in the open air, provided that adequate attention is given to such amenity considerations as odor and unobtrusiveness of the plant. (Carroll-FRC)
W82-06645

HEAVY METALS IN SLUDGE--ARE THEIR TOXIC EFFECTS ADDITIVE,
Oxford Univ. (England). Dept. of Agricultural Science.
P. H. T. Beckett, and R. D. Davis.
Water Pollution Control, Vol 81, No 1, p 112-119, 1982. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Heavy metals, *Toxicity, *Sludge, Sludge disposal, *Copper, *Zinc, *Nickel, Regulations, Crop yield, Barley, Pollution load, Land disposal, Phytotoxicity.

The amount of sewage sludge which can be safely disposed to agricultural land is highly dependent on whether or not the toxic effects of the copper, nickel, and zinc components are additive. While draft regulations in the United States and several European countries assume that these effects are not additive, those for the United Kingdom assume that they are. The concentrations of copper, nickel, and zinc in soil solutions of sludge-treated soils were investigated and the toxicity to young barley of solutions containing individual metals or mixtures of two metals was examined in an effort to establish the likely extent of additivity. These tests showed that, in the range of solution concentrations that is of practical concern, the relationship between tissue concentrations and soil solution concentrations is roughly linear, and that the relationship between soil solution concentration and heavy metal load is concave downwards. Tissue concentrations of copper, nickel, and zinc in crops on sludge-treated soils are likely to be proportional, or less than proportional, to the heavy metal load of the soil. Copper, nicke, or zinc are not likely to contribute to the total toxicity unless their quantity exceeds 50 to 67% of the quantity that would be just sufficient to cause toxicity in the absence of the other elements. These results indicate that the three elements show less additivity than is assumed in the draft regulations in the United Kingdom, but a little more than is assumed in the U.S. regulations. It would appear that sludge application rates in the United Kingdom could be doubled without increasing the risk of environmental pollution. (Carroll-FRC)
W82-06646

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-06767

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Enginerring.
For primary bibliographic entry see Field 5D.
W82-06772

LAND APPLICATION OF WASTEWATER,
Montgomery (James M.), Salt Lake City, UT.
J. H. Reynolds.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 673-675, June, 1982. 26 Ref.

Descriptors: *Literature reviews, *Water reuse, *Reclaimed water, *Irrigation water, *Land disposal, *Reviews, Impaired water use, Nutrients, Nitrogen, Phosphates, Pathogens, Bacteria, Viruses, Microorganisms, Municipal wastewater, Forages, Pastures, Water pollution effects, Soil properties, Wastewater disposal, Wastewater irrigation, Fate of pollutants, Sugarcane, Cotton, Public health.

The published literature on recent developments in land application of wastewater was reviewed. Case studies of successful application of secondary wastewater effluents were reported for grassland, sugarcane and cotton crops, and in a southern Appalachian forest. Nitrogen removal and heavy metal accumulation by different forage crops were studied. Nitrogen balances at wastewater disposal sites showed that a significant fraction of nitrogen was lost by denitrification and volatilization. Drained, cultivated, organic soils; flooded organic soils; and shallow reservoirs efficiently removed nutrients from wastewater effluents. Microbiological die-off exhibited first-order kinetics. Die-off rates were 1.14 per day for fecal coliforms, 1.33 per day for Salmonella, and 1.45 per day for viruses. Depth to groundwater was an important factor in the attenuation of pathogens in the soil. Effects of land application on the health of workers and other exposed populations, on the quality of ground and surface waters, on the food chain, and on soil physical properties were studies. (Cassar-FRC)
W82-06915

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RADIOACTIVE WASTES,
Oak Ridge National Lab., TN., Environmental Sciences Div.
B. G. Blaylock, and H. J. Alexander.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 1002-1023, June, 1982. 4 Tab, 193 Ref.

Descriptors: *Literature reviews, *Waste disposal, *Radioactive waste disposal, *Nuclear wastes, Waste storage, Water pollution sources, Fate of pollutants, Underground waste disposal, Solid wastes, Regulations, Geohydrology, Landfills, Ocean dumping, *Reviews, Incineration, Storage, Waste management, Aquatic life, Monitoring, Risks, Powerplants, Environmental effects, Financing, Economic aspects.

A review of the radioactive waste literature for 1981 listed the contents of 3 symposia in tabular form. Recent regulations published by the Nuclear Regulatory Commission, Department of Energy, and EPA were highlighted. Studies on the isolation of radioactive wastes included hydrogeological investigations of the suitability of different host rocks and sites for waste burial. It was determined that groundwater moves mainly through macrofissures and is nearly stationary in the adjacent micropores. Pressure gradients caused by the temperature differences were important. Shallow land burial of low-level waste in polyethylene drums was done satisfactorily. Several handbooks and reviews on geologic repositories were mentioned. Other authors discussed testing and modeling of the suitability of various sites for disposal with consideration of temperature changes, creep in salt formations, effects of seismic events on underground facilities, and ocean disposal. Waste treatment methods reviewed were solidification (such as spent ion exchange beads), vitrification (for example, the MODOX process for immobilizing Na ions and radionuclides in a glass matrix), volume reduction (melt refining, treatment of ion exchange resin waste, glass furnace, use of metals and slags, and chemical reactions plus filtrate of I131 wastes), and incineration. Studies on migration of radionuclides in the environment included monitoring of aquatic and terrestrial organisms, sediments, and water. Several models were developed to describe transport of radioactive materials in water, soil, and food webs. Methods used for monitoring at radioactive materials facilities such as powerplants included soil sampling, collecting wind-suspended dust, and sampling of drainage ditch water. Other topics discussed were waste management, storage, transportation, risk assessment, remedial action such as sealing uranium mill tailings sites with asphalt emulsion barriers, decomissioning nuclear facilities, and socioeconomic factors. (Cassar-FRC)
W82-06920

A CASE FOR REGIONAL SLUDGE MANAGEMENT,
R. K. Allen.
Public Works, Vol 113, No 7, p 59-62, July, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Incineration, *Transportation, Maynard, *Massachusetts, Wastewater treatment, Regional planning, Sludge thickening, Liquid sludge, Dewatering, Landfills, Land disposal, Costs, Operating costs.

Regional sludge management was advantageous for the town of Maynard, Massachusetts, for two reasons: cost effectiveness and improvement of effluent quality. The 1 mgd wastewater treatment plant at Maynard had experienced many problems with its fluidized bed sludge incinerator since startup in 1975, and management resorted to on-site landfilling of undigested sludge. In addition, discharge standards were violated 55 and 26 days per year for BOD and total suspended solids, respectively. The problems were solved by trucking liquid sludge to the Greater Lawrence Sanitary District, a 39 mgd capacity secondary treatment facility, equipped for sludge thickening, dewatering, and incineration. Costs per dry ton were as follows: onsite landfill, $250; fluidized bed incinerator, $620; and liquid sludge hauling, $323. Although landfilling was the cheapest alternative, there had been many complaints of obnoxious odors. Hauling sludge also decreased the number of days on which maximum discharge standards were violated to 15 and 18 for BOD and total suspended solids, respectively. A figure compares the annual operation and maintenance costs of on-site incineration and hauling for 10-100 miles, one-way, at flows up to 100 mgd. Cost effectiveness is also shown in graph form. It is more cost effective to incinerate on site above 10 mgd. At lesser flows, the cost effectiveness depends on hauling distance. For example, for a 2 mgd plant it is more cost effective to haul sludge up to 80 miles one-way; for a 6 mgd plant, it pays to haul only 15 miles one-way or less. (Cassar-FRC)
W82-06993

5F. Water Treatment and Quality Alteration

INFLUENCE OF OZONATION ON SULFUR, NITROGEN, CHLORIDE AND PHOSPHORUS SYSTEMS IN PUBLIC DRINKING WATER SUPPLIES,
South Dakota State Univ., Brookings. Dept. of Chemistry.
D. C. Hilderbrand.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243320, Price Codes: xx in paper copy, A01 in microfiche. Report, May 1982. 15 p, 7 Tab, 4 Ref. OWRT B-069-SDAK(1), 14-34-0001-1264.

Descriptors: *Ozone, *Water treatment, *Sulfur, *Nitrogen, *Chloride, *Phosphorous, Ammonia, Public utility, *Ozonation, Water supply, Sulfate, Phosphate, Drinking water, Potable water.

The use of ozone as a treatment process for public drinking water is of interest because other methods include a concern relative to the ingestion of chloroform and other trihalomethanes. Ozone which decomposes rapidly in water to form oxygen deters the possibility of formation of other hazardous species. Most studies on ozonation have dealt with sterilization, color, taste, and odor removal. This study investigated the effect of ozonation on the concentration of selected phosphorus, sulfur, nitrogen and chloride species present in raw drinking water supplies. The following observations were made. No effect on the concentration of either phosphate or chloride was detected. The concentration of sulfide and sulfite was reduced to below detection limit of the method used when intermediate or high concentrations of ozone was applied. The concentration of sulfide was only slightly elevated corresponding to the conversion of limited amounts of sulfite to sulfate. For the nitrogen system no effect was detected for treatment of samples containing ammonia. The nitrite concentration however was reduced to below the detection limit for the method when intermediate and high levels of ozone treatment were employed.
W82-05907

DESALINATION DIRECTORY 1981.
Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
For primary bibliographic entry see Field 3A.
W82-05908

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,
Missouri Water Resources Research Center, Columbia.
M. M. Ghosh, and T. M. Prakash.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243551, Price codes: A04 in paper copy, A01 in microfiche. Report, January, 1982. 55 p, 9 Fig, 10 Tab, 39 Ref. OWRT A-122-MO(1). 14-34-0001-1127.

Descriptors: *Water quality control, *Microbial degradation, *Drinking water, *Biochemical tests, *Bioindicators, Microorganisms, Potable water, Water analysis, Bacterial analysis, Stream degradation, Biochemistry, Organic carbon, Natural waters, Monitoring, Pollutant identification.

Research was focused on delineating the role of microorganisms in drinking water quality degradation, which can occur during water transport in pipe networks. Biofouling kinetics were studied at very low (glucose) substrate levels in simulated systems using continuous stirred-tank reactors. Biofilm growth was measured on glass slides suspended in single reactors inoculated with indigenous microorganisms present in the University tap water. Extremely dilute feed solutions were used to simulate low (5-15 mg/liter) total organic carbon (TOC) conditions typical of actual water distribution systems. Biofouling was quantitatively estimated from biofilm thickness, attached biomass and its ATP level, biofilm polysaccharides, and changes in TOC and dissolved oxygen. It was found that biofilm kinetics under low substrate conditions were similar to literature values. The substrate penetrated the entire biofilm thickness, indicating no substrate limitation. Substrate consumption rate was linear with substrate loading rate and oxygen consumpton rate. It was concluded that ATP measurement of the biofilm is a good indicator of biological activity. An ATP index is proposed for possible use for water quality change monitoring. (Zielinski-MAXIMA)
W82-05932

PLANT EXPANSION VIA HIGH-RATE PRETREATMENT,
Alabama Water Works, Birmingham.
C. D. Colee, and K. W. Henderson.
Public Works, Vol 113, No 5, p 84-86, May 1982. 1 Fig, 3 Tab.

Descriptors: *Settling tanks, *Turbidity, *Water treatment, Tube settlers, *Alabama, Birmingham, *Pretreatment.

Tube settlers were chosen as a cost saving means of expanding the capacity of the Western Filter plant in Birmingham, Alabama. A 7-month study compared operation of Basin No 2, operating at the 5 mgd conventional rate without tube settlers, and Basin No. 1, operating at rates up to 20 mgd and equipped with 3600 sq feet of tube settlers and an additional 480 linear ft of weirs. Settled water turbidities from the 2 basins were comparable. Total capacity of the plant will be expanded from 440 to 60 mgd when tube settlers are also installed in Basin No. 2. (Cassar-FRC)
W82-05953

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,
Kyoto Univ. (Japan). Dept. of Chemical Engineering.
E. Sada, S. Katoh, K. Miyai, M. Terashima, and S. Yoshida.
Biotechnology and Bioengineering, Vol 24, No 5, p 1137-1144, May, 1982. 8 Fig, 1 Tab, 4 Ref.

Descriptors: *Solute transport, *Membrane processes, Permeability, Filtration, Sieving coefficients, Hydraulic properties, Water treatment.

Homogeneous kappa-carrageenan and bovine serum albumin membranes used in reverse osmosis and other applications were evaluated. Solutes included urea, B vitamins, enzymes, and other substances with molecular weights from 60 to 68,000. The rates of hydraulic transport of water, solute permeabilities, and sieving coefficients increased with the water content of membranes. Water content, in turn, was related to pore radius. As the molecular weight of the solute increased, the ratio of diffusion coefficient of the solute in the membrane to the diffusion coefficient of the solute in water decreased, the reciprocal of the membrane thickness times the membrane resistance increased, and the sieving coefficient decreased. (Cassar-FRC)
W82-06006

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,
Compagnie Generale des Eaux, Paris (France).

For primary bibliographic entry see Field 5G.
W82-06013

PACKAGED PLANT TREATS TURBIDITY,
Mesa Engineering and Surveying Co., Inc., Montrose, CO.
R. A. Burnham, and W. C. Trnka.
Water/Engineering and Management, Vol 129, No 4, p 56-57, April, 1982.

Descriptors: *Turbidity, *Water treatment, Ridgway *Colorado, Flocculation, Package plants, Drinking water, Snowmelt.

The water supply of Ridgeway, Colorado, population 270, is pure at the source but becomes contaminated with organic and inorganic matter during its travel through 6 miles of open ditch. Turbidity is especially high during the spring snowmelt period. A package plant was installed (total cost $780,000) to upgrade water quality. The treatment process consists of flocculation with alum and cationic polymer, a depth clarifier, sand depth filters, and chlorination. The equipment treats 130,000 gpd. The facility delivers water 10 times better in quality than minimum specified standards. (Cassar-FRC)
W82-06026

FLORIDA STYLE WATER SUPPLY AND TREATMENT,
CH2M Hill, Gainesville, FL.
O. K. Buros, T. A. Ridgik, C. R. Sproul, M. R. Vilaret, and R. A. Yorton.
Water/Engineering and Management, Vol 129, No 4, p 30-33, April 1982. 3 Ref.

Descriptors: Water supply, *Water softening, *Aquifers, *Water treatment, Coastal aquifers, Sulfides, Desalination, Trihalomethanes, Chlorinated hydrocarbons, Organic matter, Hardness, Saline water intrusion, Flocculation, Aeration, Chlorination, Activated carbon, Brackish water, Water quality control, Reverse osmosis, Electrodialysis, Membrane processes, Distillation, *Florida.

Florida's abundant precipitation (163 million acre feet per year) recharges the very productive Floridan aquifer underlying most of the state and the smaller Biscayne aquifer under the southeast coast. Groundwater provides almost 90% of the state's public supply. Florida's most prevalent problems with its water supply are hardness (high Ca, low Mg), high hydrogen sulfide levels, salt water intrusion, and trihalomethane (THM) formation. As a result, treament methods have evolved. Water softening with lime or lime-soda ash is widespread. Many softening plants use potato starch as a flocculant aid to improve the sludge handling characteristics. Surface water quality is variable; it is often high in organic color. Treatment usually required is coagulation, settling, filtration, and activated carbon. Aeration has been a common process for removing hydrogen sulfide from waters. However, Orlando is using a new process based on oxidation of sulfides with chlorine prior to passage through a granular activated carbon bed. Methods of handling the salt water intrusion problem include artificial recharge of an aquifer with river water, control of large withdrawals in sensitive areas, raising canal control elevations, and relocation of wells further inland. In areas of abundant brackish water supplies desalination by electrodialysis or reverse osmosis is in use. The combination of high dissolved organic matter and bromide ions in Florida waters favors THM formation. Three possible treatment strategies are available: removal of THM precursors, removal of THM after chlorination, and alternate disinfectants. (Cassar-FRC)
W82-06027

REMOVAL OF HUMIC SUBSTANCES FROM NATURAL WATERS BY REVERSE OSMOSIS,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
H. Odegaard, and S. Koottatep.
Water Research, Vol 16, No 5, p 613-620, May, 1982. 7 Fig, 5 Tab, 5 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, *Humic acids, Water treament, Color removal, Organic matter, Sagelva River, *Norway.

Removal of humic substances from water by reverse osmosis was studied in laboratory units. The raw water from the Sagelva River, Trondheim, Norway, was high in color (average 54 mg Pt per liter). About 72% of the humic substances had molecular weights above 5000. Three reverse osmosis units were used: Osmonics spiral wound Model OSMO 519-SB, DDS plate and frame module Model 20-Lab, and PCI single tube module Model bro mk2. Membrane pore size was the most significant factor influencing permeate quality and product water flux. Pressure had no significant effect on permeate quality but was linearly related to product water flux. The concentration of humic substances in the raw water did not affect the water flux, indicating that the osmotic pressure of the humic materials did not affect the transport mechanism. The best membranes for each unit were: Osmonics SEPA 89 (permeate flux 25 liters per sq m per hour at 15 bars), DDS 865 (permeate flux 1201 sq m per hour at 40 bars) and PCI T2A (permeate flux 90 liters per sq m per hour at 15 bars). Removal efficiencies of the best membranes were 80-97% in terms of permanganate number. The presence of suspended solids in the raw water decreased removal efficiencies. In the case of 130 mg per liter suspended solids as bentonite, reduction was 50% during 3-4 hours. The suspended solids had greater effects at higher operating pressures. (Cassar-FRC)
W82-06045

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,
Massachusetts Univ., Amherst. Dept of Chemistry.
D. Atlas, J. Coombs, and O. T. Zajicek.
Water Research, Vol 16, No 5, p 693-698, May, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Corrosion, *Copper, *Chlorine, *Pipes, Chlorination, Plumbing, Water treatment, Drinking water, Hypochlorites, Hypochlorous acid.

Corrosion of copper water piping was investigated by exposing copper drillings to different concentrations of free chlorine (0 to 10 mg per liter) and different pH (5 and 8) for 24 hours and determining the dissolved copper at different intervals. Free Chlorine, rather than dissolved oxygen, was the agent most responsible for copper corrosion by chlorinated water supplies. Chlorination was more corrosive at the lower pH because of the pH dependence of the HOCl electrode reactions and the fact that hydrochlorous acid is a stronger oxidizing agent than hydrochlorite ion. To minimize copper pipe corrosion it was recommended that the water supply be adjusted to pH of 7-8 after chlorination, using sodium carbonate rather than sodium hydroxide, and that free chlorine be maintained at a level no higher than 2 mg per liter. (Cassar-FRC)
W82-06051

THEY DON'T ACTIVATE THEIR SLUDGE IN LAGOS OR LAHORE,
Loughborough Univ. of Technology (England). WEDC Group.
J. Pickford.
Effluent and Water Treatment Journal, Vol 22, No 3, p 105-107, March, 1982.

Descriptors: *Water treatment, *Developing countries, *Drinking water, *International Hydrological Decade, *Sanitation, Water management, Wastewater treatment, Rural areas, Urban areas, Water supply development, Water scarcity, Potable water, Waste disposal, Latrines.

The 1981-1990 decade, the International Drinking Water Supply and Sanitation Decade, was planned to provide a safe and accessible supply of drinking water to all of the world's population. The greatest benefit of improved water supplies in underdeveloped countries is accessibility of water. Most poor people do not connect disease and health with water quality. Most human excreta disposal in underdeveloped nations is by latrines, as sewerage systems require too much water flow to operate correctly. Where most tap supplies of safe or publicly-treated water are intermittent, contamination in the distribution system often occurs. When more advanced nations provide funds for constructing sewage treatment works, often local authorities lack the funds to staff and maintain the facilities. Unstable governments, politics, and local regious traditions and taboos may also add to the difficulties of providing water and sanitation. It is suggested that developed countries should not try to impose their technology on underdeveloped nations, but rather work with them in finding the sewage disposal and water treatment systems which would operate best within their existing way of life. Reliability in performing routine jobs on schedule and well is seen as a valuable asset to be encouraged in developing nations seeking to establish improved water management technlogies. (Geiger-FRC)
W82-06075

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,
Illinois Dept. of Energy and Natural Resources, Chicago.
S. L. Jarrell.
Document No 82/05, February 1982. 75 p, 16 Tab, 26 Ref, 1 Append.

Descriptors: *Trihalomethanes, *Water quality standards, *Water supply systems, Pollutants, *Economic impact, *Chlorination, Drinking water, Public waters, Cost, Government supports, *Cost analysis, Cost-benefit analysis, Water sampling, Groundwater, Treated water, Surface water.

Trihalomethanes (THMs) have been associated with human cancer and genetic defects in tests conducted by the U.S. Environmental Protection Agency. Proposed changes to Chapter 6 of the Illinois Public Water Supply Regulations contained in regulatory proposal R81-11 seek to control THM concentrations in Illinois' public drinking water. The EPA has set a maximum contaminant level of 0.10 mg/l for Total THMs; all Illinois public water supplies (PWS) serving more than 75,000 people must try to comply by November 5, 1981 and those serving 10,000-75,000 just approach compliance by November 5, 1983. Most (85%) of Illinois' water comes from groundwater sources and Lake Michigan, which historically have had negligible levels of TTHM. Forty-three PWS serve more than 10,000 people. Typical surface water treatments are coagulation, filtration and chlorination. Groundwater must also be chlorinated. Many PWS can lower their TTHM levels by changing chlorination points and/or replacing chlorine with another disinfectant. Estimating compliance costs is difficult for lack of statewide sampling results. TTHM sampling done in private labs will cost the PWS $45/sample vs. $22.50/sample in state labs. For 1200 samples the first year, adopting the proposal would save $27,000, and $9,622.50 a year therafter for 428 samples. Illinois would also continue receiving $1.2 million in federal funding. Economic impacts on agriculture and commerce would be negligible; the chemical industry might see minor increases. The incremental benefits of adopting the measure outweigh the costs by the $1.2 million in federal assistance plus any difference in analytical cost. (Atkins-Omniplan)
W82-06098

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering
P. C. Singer, J. J. Barry, III, G. M. Palen, and A. E. Scrivner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243734, Price codes: A07 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report UNC-WRRI-82-179, April

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1982. 127 p, 26 Fig, 31 Tab, 48 Ref, 1 Append. OWRT B-126-NC(1), 14-34-0001-9035.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Carcinogens, *Drinking water, Water treatment, Urban areas, Chlorine, Wastewater treatment, Gas chromatogaphy, Potable water, Water quality control, Water quality, Chemical treatment, Water treatment facilities, Impaired water quality, Water analysis, Chemical analysis, Chemical reactions, *North Carolina, *Trihalomethane, Pollutant identification.

Analyses for trihalomethanes (THMs) in drinking water (by gas chromatography with electrolytic conductivity detection) showed that they are formed during water treatment in nine of the larger cities in North Carolina. Furthermore, concentrations of these suspect carcinogens often exceeded the established maximum contaminant level at three of these locations. Examination of potential surrogate measures of THMs suggests that ultraviolet/absorbance and total organic carbon are good indicators of THMs and their precursors. Statistical analysis of the data was ued to identify seasonal variations, temperature effects, geographical trends, and other water quality characteristics and water treatment practices which contribute to THM formation. A standardized THM formation potential method was found particularly useful in this regard. Chlorination/coagulation practices at a Wilmington water treatment plant were studied in an attempt to assess approaches to THM reduction; it was found that THM concentrations in finished water could be substantially reduced by shifting the point of initial chlorine application to a point following sedimentation. Similar results were obtained on a laboratory scale for Chapel Hill and Raleigh waters. (Zielinski-MAXIMA)
W82-06158

APPROPRIATE SELECTION OF WATER/WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,
Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
For primary bibliographic entry see Field 5D.
W82-06162

INVESTIGATION OF THE CHEMICAL NATURE AND POSSIBLE TOXICITY OF PRODUCTS FORMED DURING THE OZONE DISINFECTION OF DRINKING WATER CONTAINING ORGANIC SUBSTANCES,
Auburn Univ., AL. Dept. of Chemistry.
W. C. Neely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254970, Price codes: A02 in paper copy, A01 in microfiche. Report, January 1981. 18 p, 3 Fig, 2 Tab, 18 Ref. OWRT A-070-ALA(1), 14-34-0001-0101.

Descriptors: *Ozonation, *Drinking water, *Chemical reactions, *Chemical analysis, *Carcinogens, Ozone, *Water treatment, Potable water, Chemical properties, Oxidation, Organic compounds, Phenols, Industrial wastes, Catalysts, Toxicity, Hazardous materials, Pollutants, Pollution sources.

The potential for formation of carcinogenic epoxides of polycyclic aromatic hydrocarbons (3,4-benzopyrene and napthalene) in drinking water through action of ozone on their dissolved or suspended forms was explored. Within the limits of the techniques used, no conclusive evidence for epoxide formation from either compound was found; Ames bioassay produced no evidence for existence of their mutagenicity following ozone treatment. In addition, the ozonization of a model organic (phenol) in aqueous solution was studied using two approaches (ultraviolet (UV) light irradiation, and metal ion catalysts) for accelerating the rate of ozonolysis in aqueous solution. It was concluded that UV-induced ozone decomposition is responsible for photo-assisted ozonization, allowing for direct calculation of the light intensity needed to obtain a given degree of accelerated ozonization under specified conditions. Testing the catalytic ability of 25 transition metals and lanthanides revealed that vanadium pentoxide, uranium dioxide, and cobalt(II) catalyzed ozone decomposition, with the latter effectively tested for phenol ozonization. The results all indicate that aqueous phenol ozonization proceeds through initial ozone decomposition to a reactive species, for which the hydroxyl radical is proposed; this is in distinct contrast to established mechanisms in nonaqueous solution. (Zielinski-MAXIMA)
W82-06173

SUPPLYING WATER TO THE RURAL COMMUNITY,
DeWild Grant Reckert and Associates Co., Rock Rapids, IA.
M. Whye, and D. Holman.
Public Works, Vol 113, No 5, p 58-60, May, 1982. 1 Fig, 1 Tab.

Descriptors: *Rural areas, *Water supply, Water distribution, Water treatment, Lincoln-Pipestone Rural Water System, *Minnesota, Pipelines, Water quality.

The Lincoln-Pipesteon Rural Water System, southwest Monnesota, is an example of a modern rural water system. It serves 900 customers in 11 communitites spread over a 70 x 25 mile area. After a feasibility study, funding was arranges ($4 milliongrant and $6.4 million loan). The completed system obtains its water from four 60-70-ft deep gravel packed wells of 400-450 gpm capacity each, fieed with submersible pumps. Water is of good quality, requiring only chlorination and fluoridation. Water is delivered by sin pumping stations/groundwater storage reservoirs with combined storage capacity of 1.1 million gallons. Outlying stations are served by four high pressure pumps. The major construction cost was the distribution system, 645 miles of main pies and 70 miles of service pipes. Billing is done according to meter reading supplies monthly by the users. Aneffective rural water system must, first of all, have enough subscribers to justify costs. Second, water must be affordable. Consumers in a rural water system have good qualtiy, reliable water for hone and livestock use. However, fire protection and irrigation water are not generally provided. (Cassar-FRC)
W82-06223

OVERHAULING A WATER SYSTEM,
Kupper (Charles J.), Inc., Piscataway, NJ.
C. H. Witte.
Public Works, Vol 113, No 5, p 74-75, May, 1982.

Descriptors: *Water distribution, *Rehabilitation, *Water treatment, Water supply, Water mains, Water storage, Tuckerton, *New Jersey, Water metering.

Water problems in Tuckerton, New Jersey, led to the acquisition of the Tuckerton Water Company by the borough municipal utilities authority. The town of 2412 year-round population and 8000 peak summer population had an antiquated distribution system, an inoperable treatment facility, and an undersized, deteriorated storage tank. Estimated costs of improvements were $2.8 million, for which financing was obtained by a loan and a grant. Renovation of the system began with the water treatment facility, in which the old filter was repaired and a new one added and new pumping and feed equipment installed. A 6 inch water main was constructed to loop the system and stabilize the pressure. A 12 inch ductile iron main replaced a 4 inch concrete main. Other improvements were an additional supply well, a 1.4 million gallon storage standpipe, replacement of 60% of the distribution system, and installation of water meters. Future work includes more improvements to the water treatment plant. (Cassar-FRC)
W82-06224

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,
Technicon Instruments Co. Ltd. (England).
D. G. Thomson.
Water Pollution Control, Vol 81 No 2, p 193-199, 1982. 2 Fig, 7 Ref.

Descriptors: *Data processing, *Microprocessors, Automation, Computers, Laboratories, Research facilities, Equipment.

In the early 1970s computer controlled water treatment plants appeared as the fist sign of revolutionary changes in the water industry in the United Kingdom. This first step towards automation of water analysis provided a solution to the problem of coping with large sample numbers, but it has since become apparent that the computation of the data which all forms of instrumentation produce is now a major problem. The fast handling of samples is meaningless if the information gained from the analyses cannot be managed efficiently. The most recent approach to such problems is the use of microprocessing equipment. The use of such equipment in an attempt to improve the performance of the analytical instrument and to increase the degree of automation involved consideration of the following features as basic in the design: flexibility in routine operation, total automation of the autoanalyzer, validation of data, direct interfacing to existing systems, and improvement in the chemical performance. The LDM system is described; it includes a SEMS solar computer which is modular and can be upgraded as the workload or organization changes. (Baker-FRC)
W82-06259

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,
Turbitrol Co., Atlanta, GA.
For primary bibliographic entry see Field 5D.
W82-06263

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06265

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
L. Fiksdal, E. A. Vik, A. Mills, and J. T. Staley.
Journal of the American Water Works Association, Vol 74, No 6, p 313-318, June, 1982. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Drinking water, *Bacteria, Water treatment, Potable water, Chlorination, Temperature effects, Disinfection, Pollutant identification.

In order to determine the optimum conditions for maximizing viable counts of bacteria from drinking water samples, various enumeration procedures were examined. Nonstandard procedures which increased bacterial count included: media that were more dilute than Standard Methods Agar, incubation periods that ranged from 2 to 13 or 14 days and longer, and an incubation temperature of 20 degrees C. The differences between the results obtained with these nonstandard methods suggests that there may be regional differences in bacterial flora which account for the differences in efficacy of enumeration procedures. Additionally, strain diversity was estimated for heterotrophic bacteria from nonchlorinated and chorinated waters. In this examination, untreated source waters had a greater diversity of bacteria than did chlorinated samples. This suggests that chlorination allows few species to survive in distribution systems. (Baker-FRC)
W82-06278

ADVANCED WATER TREATMENT FOR COLOR AND ORGANICS REMOVAL,
Dillon (M. M.) Ltd., London (Ontario).
T. A. Constantine.
Journal of the American Water Works Association, Vol 74, No 6, p 310-313, June, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Water treatment, *Drinking water, Potable water, Chlorination, Disinfection, Ozona-

tion, Activated carbon, Color removal, Humic acids, *Filtration, *Biological activated filtration.

This paper discusses and evaluates a relatively new process called biological activated filtration (BAF) in comparison to the conventional physical-chemical process that traditionally has been used to remove color and organic compounds from drinking water supplies. The BAF process can offer reduced capital and operating costs lower chemical dosage requirements, and lessen sludge-disposal problems for treatment of highly colored waters than conventional treatment programs. BAF processes would suit commonly occurring raw water conditions, and consist of the following steps: ozonation - carried out in gravity flow through contact tanks with twenty minutes' detention time after ozone contact, providing for the reaction of the most refractory organic compounds; GAC adsorption carried out in either gravity or pressure vessels, with a 20 minute period in the carbon beds being needed; stabilization via a hydrated lime slurry injected into the treated water from the BAF units to stabilize the corrosive tendency of the water; and postchlorination prior to delivery to the distribution system and storage facilities to ensure that residual concentrations sufficient for disinfection are present in the system up to each user's service. (Baker-FRC)
W82-06279

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, M. A. Meyer, and M. S. Paller.
Journal of the American Water Works Association, Vol 74, No 6, p 322, June, 1982. 1 Fig, 3 Ref.

Descriptors: *Drinking water, Microorganisms, *Standard plate count, Membranes, *Membrane filters, Pollutant identification, Water treatment, Treatment facilities.

In this study the membrane filter Standard Plate Count (m-SPC) procedure was compared with the SPC procedure using samples collected from two New England water treatment plants and distribution systems. Samples at each plant included raw water, partially treated water immediately after post-chlorination, and three samples taken within the distribution system of the plant at various transit times following treatment up to about 1 week. Computerized analyses performed on the data collected indicate that the m-SPC method is a satisfactory alternative to the SPC method. Moreover, the m-SPC method is more sensitive than SPC because it can handle sample volumes in excess of 1.0 mL. However, it is noted that the SPC procedure itself, and thus the m-SPC procedure as well, is imprecise, as it fails to enumerate a sizable portion of potable water organisms, since the choice of incubation time and medium is arbitrary. (Baker-FRC)
W82-06280

GROUNDING OF ELECTRIC CIRCUITS TO WATER SERVICES: ONE UTILITY'S EXPERIENCE,
Suffolk County Water Authority, Oakdale, NY.
A. A. Guerrera.
Journal of the American Water Works Association, Vol 72, No 2, p 82-87, February, 1980. 7 Fig, 11 Ref.

Descriptors: *Electrical grounding, *Pipelines, Equipment, *Electric currents, Water transport, Accidents, Hazards, Safety, Water quality, Sulfides, Copper, Corrosion.

The use of water service pipes for grounding of electric circuits has resulted in numerous and documented cases of deterioration of water quality, increased rates of corrosion of copper plumbing, and potential hazards to water supply personnel. The Suffolk County Water Authority in Oakdale, New York, still has more than 230,000 active services acting as secondary grounding electrodes, despite the availability of effective and approved alternate grounding systems. It has been demonstrated that if two or more electric utility customers are fed from one transformer, and there is a water pipe ground connection for each customer, some current will always flow over the grounding connections under normal conditions. This results in the utilization of water utility piping and its appurtenances for purposes other than those for which it was designed and installed. It has further been demonstrated empirically that corrosion of tubing or deterioration of water quality occurs in areas receiving the same treated water where the only apparent variable is the presence of stray electric currents. In homes where copper corrosion of the pipes has resulted in deterioration of water quality, a recording clamp-on ammeter has been used to determine whether there was current flow between the affected residences and a common transformer and to note the peaks in the current flow. In many cases the problem of copper corrosion disappeared after an insulating coupling was installed on the corporation stop at the main. A poor or damaged ground in one residence has also been shown to affect the flow of electricity and the water quality in a neighboring residence. Changes in taste and odor have also occurred where water containing sulfur was affected by a substantial current flow, with the sulfur reduced to sulfide. (Baker-FRC)
W82-06281

DRINKING WATER DISINFECTION,
Strauss and Roberts, Inc., Porterville, CA.
K. E. Longley, and B. Roberts.
Water/Engineering and Management, Reference Handbook-1982, p 26, 28-30, May, 1982. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Drinking water, *Disinfection, Chlorination, Chlorine dioxide, Ammonia, Chloramines, Ozonation, Water treatment.

The design and selection of a disinfection system requires the development and analysis of treatment objectives together with the economic and operation factors which impact on the optimization of disinfection process. The first step is good engineering practice to be followed in the selection of disinfectants and the subsequent process optimization. Primary and secondary treatment objectives for water of a known quality must be assessed, and then the disinfectant dose to attain the desired objectives must be determined. Ozone is an outstanding disinfectant that has been used extensively in Europe. Ozonation systems may be divided into four sub-systems: oxygen generation or air pretreatment; ozone generation; off-gas ozone destruction; and process control. Chlorination of drinking water is a practice undergoing only slow evolutionary change during the past few decades. Sulfur dioxide is the usual choice for a dechlorinating agent for facilities practicing chlorination. Water treatment plants using hypochlorination typically have a storage area for bulk storage of chemical. The chloramine disinfection process fell into disuse generally due to the superior quality of the water product after using hypochlorous acid. A variant of the chloramine or chlorine-ammonia process is the introduction of ammonia to the water stream after a controlled contact time with free chlorine. An effective disinfectant producing minimal trihalomethanes in the presence of their precursors is chlorine dioxide. Its use is growing for taste and odor control. Disinfectant selection requires evaluation of treatment objectives, including interrelated engineering economic, operation, health and safety considerations. (Baker-FRC)
W82-06341

PROCESSES FOR REMOVAL OF INORGANIC CONTAMINANTS FROM WATER,
Cullen Coll. of Engineering, Houston, TX.
D. Clifford.
In: Water/Engineering and Management, Reference Handbook-1982, p 31-32, 34, 36-38, May, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Water treatment, *Water supply development, Fluorides, Nitrates, Arsenic, Selenium, Reverse osmosis, Potable water, Drinking water, Electrodialysis, Alumina, Resins.

A project has been undertaken to evaluate the single contaminant removal process versus the desalting processes. This project is designed to help small communities which have inorganic contaminant problems. The single contaminant removal processes available for the engineer to chose from include alumina adsorption or ion exchange. The desalting processes include reverse osmosis or electrodialysis. To make the proper choice both technically and economically, consideration must be given to the raw water total dissolved solids level, speciation of contaminant, concentration of ions competing for adsorption or ion exchange sites, silt density index, public health risk in event of process failure or contaminant breakthrough, quality of water required for distribution, and buffer capacity to be overcome for pH adjustment. In order to design an effective process the fundamentals must be understood particularly in relation to selectivity sequence, percent contaminant passage expected, and pretreatment, post treatment and waste disposal requirements. (Baker-FRC)
W82-06342

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,
Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W82-06348

POTABLE WATER TREATMENT BY DISSOLVED AIR FLOTATION AND FILTRATION,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Journal of the American Water Works Association, Vol 74, No 6, p 305-310, June, 1982. 3 Fig, 7 Tab, 16 Ref.

Descriptors: *Potable water, *Water treatment, Domestic water, Drinking water, Disinfection, *Flotation, Filtration, *Dissolved air flotation.

This report discusses bench and pilot plant tests of a potable water treatment system consisting of chemical feeding, dissolved air flotation, gravity filtration, and disinfection. The report describes the conceptual design of the purification system, a technical feasibility study, an economic feasibility study and recommendation for future research. The system was proposed for the city of Pittsfield, 60,000 inhabitants, located in the Berkshire Hills of western Massachusetts. The water sources consist of three surface reservoirs supplying about 56 ML/day to the city and communities surrounding it. The system emphasizes the use of a dissolved air flotation (DAF) unit for water purification. Carbon absorption is proposed for removing toxic organic substances. Successful treatment of Pittsfield raw water was obtained by this system. The total annual costs for the proposed system are estimated to be $233,708, $846,888 and $4,551,998 for plants with flow rates at 3.7, 37, and 370 ML/day, respectively, which are lower than costs of a conventional system. (Baker-FRC)
W82-06353

BIOCLEANSING WITH AQUATIC WEEDS: A MEANS OF REMOVING ASBESTIFORM FIBERS FROM WATER,
Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256579, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report No 712431, December, 1980. 14 p, 1 Fig, 19 Ref. OWRT A-057-OHIO(1).

Descriptors: *Asbestos, *Drinking water, *Aquatic plants, *Electron microscopy, *Water quality control, *Elodea, Municipal water, Aquatic life, Submerged plants, Reservoirs, Potable water, Microscopy, Water supply, Reservoir operation, Quality control, Adsorption, Water storage, Water use, Water treatment.

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Research was conducted to find a suitable aquatic plant for the removal of asbestos from municipal water supplies. Aquatic plants were grown in 35 and 200 liter aquaria and exposed to known concentrations of equal parts of chrysotile and tremolite asbestos with water circulation provided by air stones. Water samples and thin plant sections were taken for asbestos analysis by electron microscopy. All plant types removed asbestos fibers to some degree, with elodea removing the greatest number per gram of plant material. Data were also obtained for pondweed, scirpus, and sagittaria. The amount of asbestos fibers removed was directly proportional to the surface area of the plant. Analysis revealed that the fibers accumulate externally on the plant surface, possibly through an electrochemical reaction. Elodea, with its many leaves, has a far greater surface area than other plants tested and also has the greater rate of growth. The study results suggest that plants should be left in reservoirs to scavenge asbestos fibers. Further study should be directed towards the use of plants in outdoor holding ponds to assess their efficacy for eliminating asbestos from drinking water at relatively low costs. (Zielinski-MAXIMA)
W82-06363

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W82-06398

GETTING YOUR MONEY'S WORTH FROM FILTRATION,
Environmental Protection Agency, Cincinnati, OH.
G. S. Logsdon, and K. Fox.
Journal of the American Water Works Association, Vol 74, No 5, p 249-256, May, 1982. 15 Fig, 2 Tab, 36 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Filter media, *Diatomaceous earth, Protozoa, Bacteria, Asbestos, Coagulation, Flocculation, Sedimentation, Backwash, Viruses, Giardia, Sand filters, Coliforms, Reviews.

Effective operation of diatomaceous earth (DE), slow sand, and rapid granular media water filtration plants is described. Among the particles which must be removed by filtration are asbestos, bacteria, clay, protozoan cysts, fine rock particles, and viruses. In DE filtration small quantities of DE as a filter aid are continuously added to the feed. Filtration takes place on a permeable septum precoated with a thin layer of DE. Coagulants are rarely used. DE filtration may be done under pressure or vacuum. Removal of Giardia cysts can reach 99.99%; asbestos fibers, 99.99%; and plankton, 100%. Turbidities of 0.10 NTU are attainable. The granular media filtration process, most commonly used in the U.S., usually includes coagulation, flocculation, sedimentation, and filtration. If raw water quality is good, sedimentation and sometimes flocculation may be omitted. Continuous monitoring of turbidity can quickly detect early filter breakthrough. Filters should be backwashed before turbidity reaches the 1 NTU level. Giardia cysts and asbestos fibers removal is effective when turbidities do not exceed 0.1 NTU. Slow sand filtration, a biological process developed in the 19th century, effectively removes bacteria. The system is most suitable for small communities because capital costs are low and large areas of land are required for the filter beds. (Cassar-FRC)
W82-06412

WATER SUPPLY AND DISTRIBUTION IN LARGER COMMUNITIES,
R. A. Pavia.
Journal of the American Water Works Association, Vol 74, No 5, p 20, May, 1982. 1 Ref.

Descriptors: *Financing, *Water treatment facilities, *Public utility districts, Chicago, Water supply, *Water distribution, Capital costs, Utilities, Rehabilitation, *Urban areas.

Water systems and other public utilities face financing crises as physical facilities age, costs increase, and consumers resist rate increases. The Chicago, Illinois, water system's financial condition is described as an example of a utility serving a large community. Although the city's allowance of $18.7 million per year for capital improvements appears to be far short of the ideal $30-50 million per year other factors must be considered. Replacement of small water mains is being delayed because redevelopment plans for some areas are not yet known. The two water purification plants (built in 1947 and 1964) are in good condition and have excess capacity for new customers. Future customers will pay the costs of extending the distribution system. Therefore, the utility expects to make a $8 million per year profit from new service by 1985. Much of this revenue will be available for capital improvements. The city is now benefiting from building a system larger than was needed at the time of construction. (Cassar-FRC)
W82-06413

ENERGY-INPUT-CONTROLLED DIRECT FILTRATION TO CONTROL PROGRESSIVE EUTROPHICATION,
Wahnbachtalsperenverband, Siegburg (Germany, F.R.).
H. Bernhardt, and H. Schell.
Journal of the American Water Works Association, Vol 74, No 5, p 261-268, May, 1982. 11 Fig, 5 Tab, 32 Ref.

Descriptors: *Eutrophied lakes, *Phosphorus removal, *Filtration, Reservoirs, Water treatment, Algae, Flocculation, Wahnbach Reservoir, West Germany, *Direct filtration, West Germany, Wahnbach Reservoir.

Phosphorus input to the Wahnbach Reservoir, near Bonn, West Germany, has been reduced since 1977 by an energy-input-controlled direct filtration process. The phosphorus elimination plant, located on the reservoir's main tributary, pumps water from a prereservoir and precipitates the dissolved phosphate with 4-10 mg per liter ferric salts. The colloidal iron compounds are destabilized by mixing during a 20 sec period. Further mixing in the agglomeration basins develops flocs large enough to filter easily. The filter medium is composed of granular activated carbon on the top, hydroanthracite in the middle, and fine sand on the bottom. Particle size decreases from 3-5 mm in the top layer to 0.7-1.2 mm in the bottom layer. The total filter area of 1200 sq m treats 432 ML per day. Removal efficiencies are: total P, 96.3%; total coliforms, 99.87%; total plate counts, 97.9%; chlorophyll, 94.9; turbidity, 99.3%; COD, 77%; dissolved organic carbon, 57.8%. Effluent water contains $<$ 10 micrograms per liter P. The trophic state of the reservoir has changed for eutrophic to mesotrophic since the phosphorus elimination plant was put into operation. Secchi depth has increased from 3 to 6 m. Species composition of algae has changed. Blue-green algae have completely disappeared, and Chlorella are present only in small quantities. (Cassar-FRC)
W82-06414

THE EFFECT OF BACKWASHING RATE ON FILTER PERFORMANCE,
Minneapolis Water Works, MN.
N. Qureshi.
Journal of the American Water Works Association, Vol 74, No 5, p 242-248, May, 1982. 8 Fig, 3 Tab, 15 Ref.

Descriptors: *Filtration, *Backwash, *Fluidized beds, Turbidity, *Water treatment, Minneapolis, Minnesota, Head loss, Filter media, Dual media filters, Mixed media filters.

Backwashing at fluidization rates (11.8 mm per sec) and subfluidization rates (8.4 mm per sec) was conducted on a plant scale in Minneapolis' Fridley water filtration plant using identical pairs of mixed media (coal, sand, ilmenite) and identical pairs of dual media (coal, sand). The plant treats Mississippi River water with lime softening followed by alum coagulation and filtration. At both backwashing rates the mixed media filters had higher turbidity during the first half hour of the runs. The low backwashing rate produced a higher turbidity peak than the high rate. After an hour into the run turbidity gradually decreased to a low at about 20 hours, then gradually increased until the end of the run at 70 hours. Head losses were similar for low and high backwashing rates in the mixed media filters. In the dual media filters turbidity peaks were also reached during the first hour, higher turbidity being produced by the low backwashing rate. At both backwashing rates turbidity leveled off at about 10 hours and remained constant until 50 hours, when it gradually increased to the end of the run, about 62 hours. Head losses were consistently higher in the low rate dual media filter than in the high rate dual media filter. Two peaks of turbidity were evident during the early stages of filter runs, the first and small peak about 1 min after the start of the run and the second and larger peak at about 10 min. Methods of handling the initial stage of turbidity include wasting the poor quality effluent or use of polymer during backwashing. Lower backwashing rates save energy and permit use of smaller tank and piping sizes. However, filter runs are somewhat shorter. No mudball formation was observed during use of low backwashing rates. (Cassar-FRC)
W82-06415

LOW-DOSAGE HIGH-RATE DIRECT FILTRATION,
Water and Air Research, Inc., Gainesville, FL.
E. G. Wagner, and H. E. Hudson, Jr.
Journal of the American Water Works Association, Vol 74, No 5, p 256-261, May, 1982. 7 Tab, 20 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, Pilot tests, Reviews, Alum, Coagulation.

The advantages of low-dosage direct filtration water treatment are emphasized in a review of the author's experiences and a review of the literature. Direct filtration is an economical process, saving costs by reduced chemical consumption, reduced single sludge load, and lower initial capital costs. Generally, in the U.S. the raw water treated by direct filtration should not have more than 15 platinum cobalt method color units and 1 NTU turbidity. Jar tests can determine the minimum doses of coagulant and polymers. Plants operating in the conventional mode can use direct filtration part-time. Pilot plant tests in several locations are described. In a California plant larger-scale tests used consistently less polymer dosage and filters performed better than the bench-scale tests indicated. Tests in Guam; Brasilia, Brazil; and Amman, Jordan, were carried out during periods of high turbidity. With proper choice of chemical dosage, filter media, and in one case, prsettlement of solids, turbidities of $<$ 1 NTU were obtained at relatively high filter rates. In several West African countries, the high cost of alum makes low-dosage direct filtration attractive. Laboratory tests on water from these regions indicate that water of turbidity $<$ 5 NTU (World Health limit) can be produced by direct filtration. The literature describes many more cases of low-dosage filtration, suggesting that this process is becoming increasingly accepted throughout the world. (Cassar-FRC)
W82-06416

LOW COST FILTRATION PLANTS FOR WATER SUPPLY OF ARDHA-KUMBHA MELA, 1980 AT HARDWAR,
J. P. Nigam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 117-118, June, 1981. 1 Fig.

Descriptors: *Drinking water, *India, *Water supply development, *Filters, *River beds, Ganges River, Potable water, *Water treatment, Coliforms, Water quality control, Chlorination, Turbidity, Suspended solids, Filtration, Sand filters, Percolating filters.

To supply drinking water to the pilgrims attending the Ardha-Kumbha Mela of 1980 at Hardware, a

low cost filter unit was installed below the Ganges River near Bijnor. The filter unit uses the river bed itself as the filter media, eliminating the need for chemicals and backwashing. The unit is connected to a pump and pipeline and a chlorination device. Comparisons of raw and filtered water showed reductions in turbidity from 75 to 2 ppm and complete elimination of coliforms. Suspended matter was removed down to 0.1 microns. The manufacturing and installation costs of this filter unit are very small and its installation is much easier in comparison with pressure filters. Once installed, the unit may be used for years without complications. (Geiger-FRC)
W82-06437

EVOLVING HIGH RATE FILTER AND USE OF CRUSHED STONE AS FILTER MEDIA,
Madhya Pradesh State Planning Board, Bhopal (India).
D. R. J. Rao.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 92-96, February, 1981. 4 Tab.

Descriptors: *Filter media, *Filtration, *Water treatment, Sand filters, Crushed stone, Rapid flow, Gravity filters, India, Laxim Narain Giri.

Selected local crushed stone filter media and sand were used in high rate filtration for over a year at the Laxmi Narain Giri water treatment plant in India. These local materials were tested as substitutes for the commonly used anthracite coal, unabailable in India. Crushed stone effective sizes were 0.4-0.7 mm, and sand effective sizes were 0.45-.7 mm. Average removal of turbidity was 76.7% in sand and 80.44% in crushed stone at a filtration rate of 80 lpm per sq m; 77.18% in sand and 87.60% in crushed stone at a filtration rate of 160 lpm per sq m. Average removal of bacteria was 69.5% in sand and 97.07% in crushed stone at a filtration rate of 80 lpm per sq m; 92.2% in sand and 95.45% in crushed stone at a filtration rate of 160 lpm per sq m. (Cassar-FRC)
W82-06440

SETTLING CHARACTERISTICS OF FLOCCULENT SUSPENSION IN DEFLUORIDATION OF WATER BY NALGONDA TECHNIQUE,
National Environmental Engineering Research Inst., Nagpur (India).
W. G. Nawlakhe, B. N. Pathak, K. R. Bulusu, and R. Paramasivam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 85-88, February, 1981. 1 Fig, 5 Tab, 4 Ref.

Descriptors: *Settling basins, *Flocculation, *Fluorides, Turbidity, Suspended solids, Design criteria, *Nalgonda technique, *Water treatment, Settling velocity, *Defluoridation.

The Nalgonda technique, which removes excess floride from drinking water, comprises addition in sequence of sodium aluminate or lime, bleaching powder and filter alum, followed by flocculation sedimentation, and filtration. Batch laboratory settling column tests (200 cm x 30 cm diameter) using this procedure were run to obtain information for designing settling basins. A curve of percentage suspended solids removal vs. surface overflow rate (SOR) was prepared. For example, for 90% removal of suspended solids the SOR was 75 cu m per sq m per day; for 60% removal, 105 cu m per sq m per day. For application to an actual design, a factor of 1.50-2.00 should be applied to compensate for the differences between theoretical and actual behavior. A factor of 2.0 would change the above SOR to 37.5 cu m per sq m per day and 52.5 cu m per sq m per day, respectively. (Cassar-FRC)
W82-06441

PRESEDIMENTATION TANKS FOR HIGH TURBID RAW WATER,
H. A. Sabannavar.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 67-74, February, 1981. 9 Fig, 3 Tab.

Descriptors: *Suspended solids, *Industrial water, *Settling tanks, *Water treatment, Sand, Turbidity, Ganges River, India, Pumping plants, Damage, Sedimentation.

Two presedimentation tanks were designed to eliminate difficulties experienced in the water treatment plant of the Antibiotics Plant, Virbhadra, India. Suspended solids concentrations in the Ganges River, the source of the raw water, reached 36,000 mg per liter during abnormal flooding and 5,000-10,000 mg per liter during normal monsoon flooding. The treatment plant was designed for a maximum of 3,000 mg per liter turbidity. Some of the problems caused by this extreme turbidity were pump and scraper damage, choking of pipes and filter beds, deposition of sand in the intake well, and frequent shutdowns for cleaning. Several modifications had been attempted--changing the course of the river, altering the bank projections, taking in water from the surface, water jets to keep sand suspended in the pump system, and additional pumps. These changes reduced sand deposits to some extent. The presedimentation system consisted of the two 37.5 x 61.5 m tanks, a pump house with four centrifugal pumps, a rising main, a 2.5 x 2.5 x 2.7 m main tank which acted as a stilling chamber, and a sludge gate. The tanks, of which one can serve as a standby, removed 78%-84% of suspended solids from 3.2-3.5 million cu m of water during a 45 day test in 1975. Suspended solids in the raw water were 200-3975 mg per liter, and total sand-silt deposits in the two tanks were 4029 and 6631 cu m, respectively. Turbidity removals averaged 10%. During an abnormal 31,000 mg per liter suspended solids period in 1976, the tanks functioned at 85% efficiency for suspended solids removal. (Cassar-FRC)
W82-06444

MEMBRANE SEPARATION PROCESSES,
Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W82-06445

M B SETTLER: A MORE ECONOMICAL ALTERNATIVE TO CONVENTIONAL SETTLER,
A. S. Gupta, and S. V. Patwardhan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 62-66, February, 1981. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Settling tanks, *Turbidity, Tube settlers, Sludge solids, *Water treatment, Wastewater treatment, Multibottom settling tanks, Bacteria, Flocculation, Design criteria, Developing countries, Rural areas, Economic aspects.

A multibottom settling tank (MBST) was developed and tested as a simple and economic water treatment option for rural and small communities. The 3 cu m pilot plant MBST consisted of four clearly divided zones: inlet, settling, outlet, and sludge. The settling zone was made of four units. Each unit consisted of 15 inclined plates. The plant performed as well as a conventional treatment plant at a flow depth of 50 cm or greater, an angle of inclination of 45 degrees, horizontal velocity of 12 cm per sec. surface loading of 6.66 liters per sq m per min, and detention time of 15 min. Total depth of flow, long runs, or shock loading had no significant effect on turbidity removal efficiency. Residual turbidity increased with increasing angle of inclination of the plates, with increases of horizontal velocity above 10 cm per min, and with increases in surface loading. Combining the MBST with a solid media flocculator containing hard coke produced bacterial removals of 83-96% (MPN test). The combined unit requires little electricity or skilled labor. Costs are 67-89% less than for a clariflocculator. (Cassar-FRC)
W82-06446

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,
University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
K. R. Stimson, and A. Brameller.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 154-157, March, 1982. 2 Fig, 1 Ref.

Descriptors: *Network design, *Water distribution, *Computer programs, Simulation analysis.

An interactive graphical computer program, a version of the WATNET program, for network analysis of a water distribution system is described. This offers an improvement over the batch process, which requires a significant amount of work before and after computer processing. The graphical program, written in FORTRAN, may be used for network design, reinforcement, simulation, contingency planning, operation, and loss minimization. (Cassar-FRC)
W82-06453

THE PRODUCTION OF PUBLIC SUPPLY DRINKING WATER FROM RUTLAND WATER AT THE WING TREATMENT WORKS,
Anglian Water Authority, Northampton (England). Pitsford Lab.
D. B. Ford, B. E. Drage, and T. J. Roberts.
Hydrobiologia, Vol 88, No 1-2, p 103-116, March, 1982. 1 Tab, 6 Fig, 1 Ref.

Descriptors: *Reservoirs, *Water supply, *Drinking water, *Water treatment, *Water storage, Water quality, Potable water, Reservoir storage, Water treatment facilities, Chemical treatment, Haloforms, Bacteria, Sludge, Chlorine, Water quality data, Rutland Water, England.

Water is taken from Rutland Water for treatment to potable standards at the Wing Water Works. Since the Wing Water Works opened in 1977, chemical and bacteriological samples of the component waters of the reservoir have been analzyed. In general, turbidity, color, and residual iron have all been low with a high degree of consistency following treatment. Nitrate and sulfate were both fairly high when the reservoir was first filled, but they have steadily declined. Trace quantities of haloforms are produced in the treatment process at Wing. The predominant one is dichlorobromethane; chloroform and dibromochloromethane are also produced at lower and roughly similar concentrations. Although no formal limit exists, a tentative guide level of 100 micrograms per liter for total haloforms has been suggested. (Titus-FRC)
W82-06474

CIRCULATION PATTERNS; THEIR INVESTIGATION AND PREDICTION,
Leicester Polytechnic (England). School of Life Sciences.
E. J. Myers, R. S. Oldham, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 67-77, March, 1982. 1 Tab, 7 Fig, 7 Ref.

Descriptors: *Wind, *Currents, *Algae, *Model studies, Water treatment, England, Reservoirs, Water supply, Water quality, Algal growth, Algal control, Eutrophication, Rivers, Biomass, Primary productivity, Wind-driven currents, Rutland Water.

The effect of wind on the water currents in Rutland Water is being studied with a view to predicting algal distribution patterns so that, by exercising different abstraction options, water treatment problems can be avoided. Investigations using a physical scale model of the reservoir in a wind tunnel suggest that under most wind directions the circulations tend to separate the water body into three distinct topographic regions. Water currents in the reservoir itself have been plotted by tracking the paths of drogues using theodolites. This has indicated that in the central basin the circulation may be of the 'conveyor belt' type rather than the solely horizontal type of the model. Surface chlorophyll readings are shown to indicate wind-driven water currents. Algal distribution has been predicted from wind data; however, the analysis requires modification in order to apply to all wind conditions. Wind will mix surface blooms of algae into deeper water. Strong winds acting on water with weak or non-existent stratification can cause

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mixing throughout the whole depth of the reservoir so that abstracting from depth to avoid surface blooms is not feasible. However, provided there is strong stratification, this mixing may only occur within the upper layer of water, in which case water abstracted from below the thermocline will have a reduced algal content. (Titus-FRC)
W82-06477

OPTIMUM USE OF CHLORINE IN CIRCULATING WATER,
Indianapolis Power and Light Co., IN.
G. Brown, and C. McCloskey.
Industrial Wastes, Vol 28, No 3, p 24-26, May/June, 1982. 3 Fig.

Descriptors: *Electric powerplants, *Cost analysis, *Fouling, *Condensers, *Chlorine, Biocides, Chlorination, Electrical equipment, Slime, Cooling water, Operating costs, *Water treatment, Industrial water.

The H. T. Pritchard power station, which provides electrical power during periods of peak usage for the Indianapolis Power & Light (IPL) Company, is cooled by once-through river water and often experiences biological fouling of the condensers. In 1974, a program was started to optimize the use of chlorine (used to control biological fouling) to reduce operating costs and maintain chlorine discharge levels within the range of anticipated future standards. The Pritchard facility is located downstream from the discharge of the Indianapolis sewage treatment plant, which contributed tremendously to biofouling and loss of generation efficiency, especially during summer months. Studies to optimize chlorine use involved the testing of chlorine enhancer to help the biocide penetrate the fibrous slime masses generated by microorganisms. Comparison of turbine generator units with and without the penetrator showed a faster development of slime after chlorine use without the penetrating agent. Tests were conducted in 1979 to optimize the feed rate of the penetrating agent and the plant's operations in warmer weather. Experiments in 1980 used a small sidestream condenser as a control unit from which to extrapolate chlorination rates for the larger IPL units. Cost savings as a result of these efforts amount to $6,250 annually. (Geiger-FRC)
W82-06498

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,
Metcalf and Eddy. Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06511

INFLUENCE OF STABILIZER CONCENTRATION ON EFFECTIVENESS OF CHLORINE AS AN ALGICIDE,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
M. R. Sommerfeld, and R. P. Adamson.
Applied And Environmental Microbiology, Vol 43, No 2, p 497-499, February, 1982. 3 Fig, 7 Ref.

Descriptors: *Algicides, *Chlorine, Toxicity, Swimming pools, *Water treatment, Chemical treatment, Chlorination, *Cyanuric acid.

Cyanuric acid or the compounds of chlorinated cyanurates are frequently used in swimming pools to reduce the loss of free chlorine by ultraviolet radiation. Several studies have investigated the influence of cyanuric acid on the bactericidal efficiency of chlorine; however, the effect of this stabilizer on the algicidal efficiency of chlorine has not been studied. This investigation showed that cyanuric acid has a relatively minor effect on the algicidal efficiency of free chlorine. When inhibiting, but less than algicidal, concentrations of chlorine were used, the addition of 25 milligrams of cyanuric acid per liter slightly reduced the toxicity of free chlorine to three swimming pool algae. Higher stabilization concentratins, ranging from 50 to 200 milligrams per liter, generally resulted in no further reduction in the algicidal efficiency of free chlorine. (Carroll-FRC)
W82-06539

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W82-06543

FACTORS THAT AFFECT USE OF DIRECT FILTRATION IN TREATING SURFACE WATERS,
West Virginia Inst. of Tech., Montgomery. Dept. of Civil Engineering.
R. F. McCormick, and P. H. King.
Journal of the American Water Works Association, Vol 74, No 5, p 234-242, May, 1982. 5 Fig, 5 Tab, 29 Ref, OWRT A-081-VA.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, *Virginia, Surface water, Alum, Coagulation, Polymers, Filter media, Color removal, Algae, Bacteria.

Surface waters from five locations in Virginia were treated by direct filtration in a pilot plant. Raw water quality was variable: 1.2-24 NTU turbidity, 0-42 APHA color units, 40-20,000 algal colonies per ml, 0-2300 per 100 ml total coliforms, and 1.5-13.5 C temperatures. The most effective treatment was a 3 minute rapid mix with alum and a cationic polymer. Filtration at 3.5 mm per sec through 51 cm of 1.3 mm anthracite coal and 25 cm of 0.45 mm silica sand was more effective than the other two filters tested--a mixed media filter of coal, sand, and garnet, and a dual coal-sand filter with 1.7 mm size coal. The filtered water met the 0.1 NTU standard if raw water characteristics were within the following ranges: turbidity, 0-10 NTU; color, 0-15 APHA units; algae, 0-1000 clumps per ml. Water with high individual parameters was succesfully treated if the other parameter values were low. Runs made at temperatures of 4 and 6 C were satisfactory, indicating that low temperatures did not adversely affect the filtration process. (Cassar-FRC)
W82-06579

METAL REMOVAL 'A LA CARTE',
J. C. Ginnocchio.
World Water, Vol 5, No 5, p 30, 32-33, May, 1982. 8 Fig, 1 Tab.

Descriptors: *Metals, *Flocculation, *Water treatment, *Wastewater treatment, Heavy metals, Iron, Manganese, Silver, Arsenic, Barium, Cadmium, Chromium, Copper, Mercury, Selenium, Lead, Zinc, Industrial wastewater, Alumina, Activated carbon, Trace metals, Chemical precipitation, Sedimentation, Filtration, Hydrogen ion concentration, Adsorption.

Methods of removing undesirable trace metals from drinking water are described. Fe and Mn levels are reduced by aerating the water and filtering the precipitated, oxidized metals. Fe-humic complexes may be removed by flocculation-filtration. Flocculation-sedimentation can be used to remove Ag, As(5+), Ba, Cd, Cr(3+), Cu, Hg, Se(4+), Ni, Pb, and Zn. The process is pH-dependent. Removals at pH 6.5-7.0 using 5 mg per liter of trivalent iron are 90% for Pb, As(5+), and Cr(3+), almost zero for Ba and Cr(6+), and 24%-78% for the other metals. A pH of 7.5-8.5 and the same flocculant dose improves Ag, Cd, and Hg removal but decreases Se(4+) removal. Ba and Cr(6+) are not affected. Addition of ferrous sulfate, however, removes 95% of Cr(6+). A pH of 10.0-10.5 separates most of the metallic ions in sloped tube settlers. Cr(6+) and Se(4+) levels are not satisfactorily decreased (< 25% removal). Flocculation-filtration removes metals (Pb, Cd, Cu, Ag, and Zn) from industrial wastewater, but Ag and Ni levels are not significantly decreased. Activated alumina can remove Se and As with maximum efficiency at pH 5.0-5.5. Activated carbon filters eliminate inorganic and organic Hg compounds. (Cassar-FRC)
W82-06608

MAKING CHLORINATION TRUSTWORTHY,
Fischer and Porter Co., Warminster, PA.
W. H. Nagel.
Water/Engineering and Management, Vol 129, No 7, p 38-39, June, 1982. 6 Fig.

Descriptors: *Monitoring, *Chlorination, *Control systems, *Water treatment, Electrical equipment, Disinfection.

Several methods are suggested to ensure that chlorine concentrations in the water treatment process remain within the desired range. Limit switches automatically signal by alarm light or horn that an abnormal condition is present. High and low vacuum switches indicate a variety of troubles in the system. The high vacuum switch detects deplated chlorine supplies, clogging, and blockages. It may be connected to a well pump to prevent pumping of unchlorinated water. The low vacuum switch indicates ejector failure and closing of valves in water or chlorine solution lines. A direct current signal monitors the chlorine gas flow and signals departures from the set limits. The above three systems provide instantaneous information to the operator. Trip switches may be attached to a chlorine residual recorder. This measures the most reliable parameter, chlorine residual, but there is a 4-8 min delay period, during which no chlorination may be taking place. Another approach involves supervision of incoming electrical signals from a mainline water flow transmitter and/or chlorine residual analyzer controller. The methods listed in this paper may be used in various combinations to increase the reliability of the monitoring system. (Cassar-FRC)
W82-06639

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,
Brown and Caldwell, Walnut Creek, CA.
D. T. Merrill, and D. S. Parker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256835, Price codes: A04 in paper copy, A01 in microfiche. OWRT Report, February, 1982, U.S. Department of the Interior, Washington, DC. 42 p, 9 fig, 15 Tab, 5 Ref, 3 Append. OWRT C-90070-R(No 9413)(1), 14-34-0001-9413.

Descriptors: *Industiral water, *Tertiary wastewater treatment, *Sealing, *Corrosion control, *Ozonation, *Cooling water, Cooling, Cooling towers, Air conditioning, Economic aspects, Municipal wastewater, Ozone, Corrosion, Fouling, Deterioration, Water treatment, Calcium compounds.

Study was undertaken to determine whether the beneficial performance of ozone (biofouling, corrosion, and chemical scaling control), when used as the sole source of cooling water treatment for air-conditioning systems, could be obtained at higher cooling water temperatures typical of industrial cooling with secondary municipal effluent (SME) used as the cooling medium. A pilot cooling system was constructed, and a 6-month experimental study initiated to determine process limits, mechanisms of scaling inhibition by ozone, and to evaluate factors influencing technical/economic feasibility. It was found that, while ozone used adequately controlled corrosion and biofouling, chemical scaling could not be prevented at conditions necessary for significant economic justification. Calculations indicate that the makeup waters (SME) used will become saturated with respect to calcium phosphate at less than 2 cycles of concentration; hence, a scaling potential exists at conditions less stringent than those used in the present study. It is recommended that ozone for scaling elimination in recirculating industrial cooling systems be dropped from further consideration where the makeup water is SME. (Zielinski-MAXIMA)
W82-06709

ULTRAVIOLET SYSTEMS IN WATER TREATMENT,
C. Jevons.
Effluent and Water Treatment Journal, Vol 22, No 4, p 161-162, April, 1982. 1 Tab.

Descriptors: *Disinfection, *Ultraviolet radiation, *Microorganisms, *Water treatment, Bacteria, Yeasts, Molds, Viruses, Protozoa, Algae, Parasites.

Guidelines are presented for selection and application of ultraviolet (UV) systems for disinfection in water treatment plants. Selection of an accurate sensor, which only responds to the germicidal wavelength, can prevent loss or reductions in intensity caused by lamp failure, malfunctions, or deterioration and poor water quality. It can be incorporated in an alarm system or automatic shut-off valve to prevent inadequately treated water from passing into the distribution system. Automatic switches are available to shut off lamps during no-flow periods. This prevents overheating of the equipment. A UV sterilizer unit must be selected so that it does not operate beyond its design capacity. A table is given describing the required energy for various microorganisms. These are (in microwatt sec per sq cm) 2,500-26,400 for bacteria, 6,600-17,600 for yeasts, 11,000-330,000 for mold spores, 6,600-440,000 for viruses, 22,000 for Chlorella, 200,000 for paramecium, and 9,200 for nematode eggs. The proper location of the UV unit should be as near as possible to the first take-off point in a straight line system for no storage or dead legs. A system with storage, ion exchange, filters, etc. offers many opportunities for bacterial growth. To prevent bacterial contamination in systems with raw water containing < 100 bacteria per ml, a UV unit should be installed prior to any other water treatment step. For less contaminated raw water, periodic sterilization is sufficient. Suggestions for location of the UV unit are given for systems with a treated water storage tank (on a continuous loop with 2 hours circulation time), large systems (point of use), and high purity systems (prior to the submicron filter). (Cassar-FRC)
W82-06726

GEOSMIN AND 2-METHYLISOBORNEOL FROM CYANOBACTERIA IN THREE WATER SUPPLY SYSTEMS,
Southern California Metropolitan Water District, La Verne.
G. Izaguirre, C. J. Hwang, S. W. Krasner, and M. J. McGuire.
Applied and Environmental Microbiology, Vol 43, No 3, p 708-714, March, 1982. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Water treatment, *Drinking water, *Organoleptic properties, *Water supply systems, Water quality, Taste, Odors, Odor-producing algae, Taste-producing algae, Algae, *California, Reservoirs, Pipelines, Lakes, Geosmin, 2-Methylisoborneol, Cyanobacteria, Bacteria.

In efforts to solve objectionable taste and odor problems in drinking water in California, four different filamentous cyanobacteria were isolated from three water supply systems. The first, Oscillatoria curviceps, was isolated from a widespread infestation in the littoral zone of Lake Mathews. The second, O. tenuis var. levis Gardner, was isolated from a sediment sample taken from Phoenix Lake. A third, O. simplicissima Gomont, was isolated from a raw water pipeline downstream from Lake Mathews, where it was growing among a tangled mass of dead Cladophora. The fourth, Anabaena scheremetievi Elenkin, was isolated from a mixed bloom in Tinemaha Reservoir. Each of the water supply systems served by these water bodies had experienced taste and odor problems. Unialgal cultures, free of actinomycetes, were purged using the Grob closed-loop stripping analysis method, and the resulting methylene chloride extracts were analyzed on a gas chromatograph/mass spectrometer. Geosmin was produced by O. simplicissima and A. scheremetievi, and 2-methylisoborneol was produced by O. curviceps and O. tenuis. These compounds are the two major causes of earthy-musty tastes and odors in water. In three instances, the major odorant found in culture was previously identified in the water or sediment sample from which the respective organism was isolated. O. curviceps was implicated in a taste and odor episode involving 2-methylisoborneol in a major reservoir. Geosmin and 2-methylisoborneol were easily detected with culture samples of only 4 to 25 ml. (Baker-FRC)
W82-06740

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W82-06768

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,
Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.
C. B. Fliermans, G. E. Bettinger, and A. W. Fynsk.
Water Research, Vol 16, No 6, p 903-909, June, 1982. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Cooling towers, *Bacteria, Public health, Water treatment, Chlorination, Human diseases, Legionella pneumophila , Industrial water, Water pollution sources.

Open recirculating cooling tower systems and evaporative cooling air conditioners were studied for levels of Legionella pneumophila. The cooling towers studied were mechanical updraft systems with circulation rates of 750-83,000 gal/minute. Sources of make-up water were varied but included well water and public and private potable water. In most cases the cooling towers were chlorinated intermittently, with the treatment dose adjusted to achieve a free residual chlorine level of 0.2 to 1.0 mg/liter for a given frequency. Regardless of the biocidal treatment, the source water or the frequency of biocidal addition, every tower tested contained L. pneumophila at detectable levels. The survey data from the South Carolina towers indicated that those supplied from underground wells had lower densities of L. pneumophila than towers receiving surface water. None of the systems showed an obvious seasonality trend for the bacteria densities. The data suggest that if continuous chlorination were stopped before L. pneumophila concentrations declined to levels comparable to densities in the source water, rapid infection of the tower would occur. Thus it was concluded that even in a well maintained cooling system, L. pneumophila does occur, and elevated numbers may be reduced through chorination. (Baker-FRC)
W82-06769

COMPLEX SEQUENCE TREATS FLUCTUATING FLOWS,
World Water, Vol 5, No 6, p 30-31, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Industrial water, *Ion exchange, *Water softening, *Water treatment, Martfui Vegetable Oil Works, Tisza River, *Hungary, Boiler water, Cooling water, Process water, Firefighting water, Suspended solids, Filtration.

An unusual, complicated water treatment system produces industrial water for four purposes at the Martfui Vegetable Oil Works in Hungary from Tisza River, a highly variable raw water source. The plant requires boiler feed water, cooling water, process water, and firefighting water. Suspended solids in the river water fluctuate from 10 to 3000 mg per liter; oxygen demand, from 3 to 20 mg per liter potassium permanganate; and total hardness, 5 to 16 degrees, (German Scale). The process water and firefighting water are produced by heating the raw water to 20 C with waste stream, passing it through lime-softening reactors, and pressure filtration. The process water is treated further by ion exchange desalination to make high quality boiler feed water and by chlorination and addition of algicides, bactericides, and sodium hexametaphosphate corrosion inhibitor to make cooling water. (Cassar-FRC)
W82-06814

A GUIDE TO TREATMENT FOR BACTERIAL PROBLEMS,
National Water Well Association, Worthington, OH.
S. Smith.
Water Well Journal, Vol 36, No 7, p 46-47, July, 1982.

Descriptors: *Bacteria, *Disinfection, Wells, *Chlorination, *Water treatment, *Well water.

Wells may be disinfected with two complementary techniques--shock treatment (single-dose cleaning and disinfection) and an in-well disinfection device (chlorination by chemical feed pumps or pellet dispensers). Activated charcoal filters are available to remove chlorine taste and organic compounds, if desired. Ceramic micropore filters can serve as a final quality control for bacteria-free water. For prevention and treatment of bacterial problems in wells, the following are recommended: chlorinate drilling water and disinfect downhole equipment and casing, chlorinate the new well with a 25 ppm C1 residual, wash gravel packing in chlorinated water, test water samples regularly for bacterial count, use shock chlorination at 1000 ppm for 24-48 hours if low concentrations of bacteria are found, and install permanent chlorination if iron or sulfur-oxidizing bacteria are a continuing problem. (Cassar-FRC)
W82-06847

5G. Water Quality Control

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
For primary bibliographic entry see Field 5D.
W82-05913

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. M. Wright, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243437, Price codes: A07 in paper copy, A01 in microfiche. Report, Januay 1982. 128 p, 28 Fig, 17 Tab, 76 Ref, 7 Append. OWRT A-056-PA(1), 14-34-0001-1140

Descriptors: *Phosphorus removal, *Mathematical models, *Aquatic productivity, *Environmental effects, *Stream improvement, Phosphorus, Water quality standards, Respiration, biomass, Aquatic productivity, Nutrient requirements, Domestic wastes, Wastewater, Model testing, Aquatic plants, Aquatic populations, ecological effects, Rehabilitation, Regeneration.

Assessment was made of water quality and growth magnitude of rooted aquatic plants in a nutrient-enriched shallow stream system to provide a basis for evaluating the recovery of the ecosystem following implementation of a phosphorus (P) removal program. this program utilized spray irrigation of treated domestic waste water. Field studies were used to define temporal and spatial changes of aquatic plant biomass in selected study areas. A plant biomass model was evaluated, refined and calibrated to predict macrophyte biomass change as a function of varying environmental factors. The potential of this model as a management tool to assess the impact of nutrient reductions on stream oxygen budgets was studied. the model defined the biomass production rate as a function of specific photosynthetic and respiration rates, advective loss, and plant mortality. An empirical equation defining photosynthetic rates as a function of irradiance, nutrient availability, temperature, and plant maturity was formulated. From Michaelis-Menton kinetics, half-saturation constants of 313 kcal/sq m/day and 4.7 micrograms/liter P were estimated for light intensity and P functions, respectively. The empirically-derived value for the maximum specific photosynthetic rate for the study stream was 0.572/day. Monthly plant respiration rates were deducted from biomass simulations using literature-derived plant mortality rates. (Zielinski-MAXIMA)
W82-05919

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EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
For primary bibliographic entry see Field 6G.
W82-05923

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,
For primary bibliographic entry see Field 6E.
W82-05986

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,
Compagnie Generale des Eaux, Paris (France).
F. Damez, and M. Rapinat.
Aqua, No 2, p 397-406, 1982. 24 Fig, 28 Ref.

Descriptors: *Water quality control, *Water treatment, *Reservoir construction, *Design criteria, *Multipurpose reservoirs, Reservoirs, Storage reservoirs, Ammonia, Turbidity, Water quality management, Mixing, Injection, Water supply, Organic compounds, Equalizing basins.

The Mery-sur-Oise storage basin was designed to allow sheets of pollution from the Oise river to pass by while raw water supplies continue to feed in to the Oise water treatment plant. The basin was also intended to homogenize water quality by a process similar to that governing the biological purification taking place in waterways. Limnological studies were conducted to check whether the biological development of the reservoir, and of algae in particular, entails a deterioration of water quality. Results showed that the action of the injectors brought algae into constant contact with zooplankton which destroyed them. Pilot operations showed that storage allowed turbidity abatements of about 60%, a drop in the organic content of 30%, and an ammonia reduction of approximately 30%. The technical developments of the basin have successfully combined water quality objectives with water supply goals. (Geiger-FRC)
W82-06013

IMPACT OF THERMAL STANDARDS ON POWER PLANT WATER CONSUMPTION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta, and T. E. Croley,II.
Water Resources Bulletin, Vol 17, No 3, p 423-430, June, 1981. 5 Fig, 1 Tab, 10 Ref. A-061-IA. 14-34-0001-9017.

Descriptors: *Thermal discharges, *Standards, *Powerplants, Cooling water, Effluent standards, Thermal water, Water consumption, Missouri River, Mississippi River, Water loss, Evaporation, Rivers, Electric powerplants.

The EPA has mandated that powerplant thermal discharges into natural rivers will not be permitted after July 1, 1983. This paper shows the powerplant water consumption (evaporative water loss) for free discharge, no discharge, and several temperatures between these extremes for existing and proposed plants along the Missouri and Upper Mississippi Rivers in the Mid-Continent Area Power Pool. For the Upper Mississippi River, the difference in annual water consumption between free discharge (105.6 million cu meters, no cooling towers) and no discharge (148.1 million cu meters, enclosed cooling systems) is 42 million cu meters or 40%. For a temperature rise of 3 F above normal, water consumption would be 128.9 million cu meters, the same as the existing situation (37.3 million cu meters evaporation from the river surface and 91.5 million cu meters evaporation from cooling towers). Temperatures 1 or 2 F above normal produce almost the same evaporative loss, about 129 million cu meters. Figures for the Missouri River show a 6.5 million cu meter spread (10%) between free discharge (61.3 million cu meters) and no discharge (67.8 million cu meters). There is no significant increase in water consumption at 2 or 3 decrement from the allowable 5 F temperature rise. In areas where existing temperature standards overprotect the environment at the expense of increased water losses and energy usage, the standards should be adjusted to reflect a desirable balance between environmental protection and the costs of energy production cooling. (Cassar-FRC)
W82-06057

NEW DIRECTIONS IN WATER POLLUTION CONTROL,
Environmental Protection Agency, New York. Region II.
R. T. Dewling.
Clearwaters, Vol 12, No 1, p 7, March, 1982.

Descriptors: *Water pollution control, *Reviews, Legal aspects, Federal jurisdiction, Management, Planning, *Environmental Protection Agency.

Reform processes currently being undertaken in the water pollution control program as directed by the Environmental Protection Agency (EPA) are outlined briefly. The recent amendment of the municipal wastewater treatment construction grants program focuses efforts on achieving results through reduced federal involvement and increased state delegation. A problem of inefficiency of wastewater treatment plants in region II seems to result from a non-compliance factor. A diagnostic review of treatment plants in the region has been started, involving four phases: preliminary investigation, on-site inspection of every aspect of plant operations, identification of problems and drawing conclusions, and solution and implementation planning with both short and long term corrective actions. EPA has also begun a campaign of collecting overdue bills, which amount to millions of dollars nationally. Use of funds on actions which work directly toward improving water quality is stressed. Ocean dumping of sludge is being investigated. (Baker-FRC)
W82-06071

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 4A.
W82-06097

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12
Huff and Huff, Inc, Chicago, IL.
L. L. Huff, and J. E. Huff.
Illinois Department of Energy and Natural Resources, Chicago, Doc No 82/08, April, 1982. 78 p, 5 Fig, 21 Tab, 14 Ref, 1 Append.

Descriptors: *Combined sewer overflows, *Water quality standards, *Economic impact, *Primary wastewater treatment, *Secondary wastewater treatment, Wastewater, Effluents, Cost, Environmental effects, Heavy metals, Bacteria, Cost-benefit analysis, Biological oxygen demand.

East St. Louis discharges to the Mississippi River a primary effluent as well as combined sewer overflow (CSO); a regional plant is under construction to provide secondary effluent treatment. The city has petitioned the Pollution Control Board to exempt it from Rule 602. To comply with the rule would cost $20.9 million plus annual cost of $3.19 million. Treating first flush only would still require a $14.3 million investment. The city examined four control alternatives including combinations of first flush storage and treatment, treatment in the new plant, chlorination, and use of bar screens. The environmental effects of CSO discharges were categorized as to heavy metals, bacterial concerns, and deoxygenating waste characteristics. Iron and fluorides were potential problems, but if East St. Louis meets all water quality standards, the environmental effects would be nil. Bacterial levels can be controlled by regional disinfection. Deoxygenating wastes from CSO is the main factor in determining CSO control. Present CSO loading is about 0.81 million pounds of BOD5 per year. The treatment plant annually discharges about 6.1 million pounds; therfore, the city is one factor in maintaining overall water quality. With existing conditions, the maximum DO violation rate is about 1.1days/year; first flush treatment could lower the rate to 0.33 but the unit costs triple. Full compliance with Rule 602 would lower the violation rate to 0.26 days/year. The cost to East St. Louis of secondary treatment could boost sewerage expenses 3 to 4 1/2 times (total annual cost: $4.4 to $5.6 million), and such increased obligations would cause serious adverse effects on other municipal services. (Atkins-Omniplan)
W82-06099

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,
Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
D. S. Sawicki, L. B. Judd, G. Eggeleston, C. Bluemke, and D. Dupies.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243627, Price codes: A04 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS WRC 82-01, 1982. 59 p, 6 Tab, 11 Ref, 1 Append. OWRT A-089-WISC(1), 14-34-0001-1153.

Descriptors: *Water quality management, *Nonpoint pollution sources, *Institutional constraints, *Urban planning, Surveys, Water quality, Water quality control, Pollution load, Institutions, Water pollution prevention, Urban areas, Urban runoff, Water pollution control, Management planning, Water pollution sources, Urbanization.

Two approaches to address problems associated with nonpoint water pollution sources and institutions and processes charged with solving these problems are discussed. The first approach considered nonpoint source problems (especially for urbanizing areas) and available methods for their control. Problem solutions were classified, and used to further the understanding of institutional considerations for controlling nonpoint water pollution sources. The second approach undertook an examination of seven urbanizing communities in southeastern Wisconsin, assessing their abilities and willingness to deal with nonpoint water pollution sources, and considered the need for encouragement/reward by a higher unit of government. It was concluded that pollution reduction must be established as an objective for each of many administrative units with one unit as the prime motivator; the State has the administrative/technical/financial resources to measure problems, identify solutions, and delegate authority for effecting the solutions where appropriate. A third approach, considering an analysis of current nationwide efforts to implement nonpoint source controls for water pollution, is addressed in a separate report. (Zielinski-MAXIMA)
W82-06147

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06153

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5B.
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 5B.
W82-06159

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,
San Francisco Bay Inst., CA.
For primary bibliographic entry see Field 6E.
W82-06182

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,
Mathes (John) and Associates, Inc., Columbia, IL.
G. M. Mathes.
Civil Engineering (New York), Vol 52 No 6, p 58-59, June, 1982. 2 Fig.

Descriptors: *Aquifers, *Oil pollution, Groundwater pollution, Water quality, Wells, Monitoring, Pipelines, Water pollution prevention, Water pollution sources, Hartford, *Illinois, Oil refineries, Oil recovery.

Fires and odors kept reccurring in and around the Village of Hartford, Illinois, during the period from 1966 through 1978, with greater frequency of occurrence being noted in the spring of 1978. Study indicated that man-made and natural sources of combustible air-gas mixtures were present in and near Hartford. Some of the odors were coming from an underground accumulation of spilled petroleum products trapped on top of groundwater of the Mississippi aquifer which underlies a major part of the East St. Louis metropolitan area. Petroleum products in the spill were presumably lost from underground pipelines which traverse the Village between the refineries and shipping terminals on the Mississippi River. Early containment and recovery of any major quantities of the spilled petroleum products were of paramount concern. A comprehensive network of monitoring wells was installed throughout a significant portion of the Village. These wells permitted the preparation of contour maps and cross section drawings. Three main pools of the petroleum product were located. Two containment and recovery system designs were prepared. These allowed for recovery of spilled petroleum in virtually pure form and included consideration of the seasonal and historical fluctuations in the aquifer, the possible need for low volume pumping to create local increases in the gradient at a future date to expedite flow, and the possible need for high capacity wells to change flow gradients throughout the area should migration begin. Reports of odors have decreased. The performance and the economic efficiency of the recovery systems have minimized the cost of managing the spill. (Baker-FRC)
W82-06185

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,
Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
D. T. Lordi, C. Lue-Hing, S. Whitebloom, and R. Lanyon.
Industrial Wastes, p 16-18, 20, 25, March-April, 1981. 4 Tab.

Descriptors: Water quality control, *Industrial wastewater, *Water quality standards, *Mathematical studies, Water pollution prevention, Water pollution control, Water pollution, Industrial wastes, Heavy metals, Cadmium, Sludge.

The calculation of removal credits, the credit given by Publically Owned Treatment Works (POTW) to industries attempting to control their output of water pollutants, is described and some restrictions and conditions which must be met in order for a POTW to grant removal credits are discussed. The basic determination and calculation of removel credits are discussed. The basic determination and calculation of removal credits are presented, along with some restrictions on the calculation of consistent removal. For POTW that bypass untreated wastewater to receiving waters at least once annually, two alternatives exist for applying for removal credits. Under the first alternative, specific conditions must be met by the POTW and the industries involved, while under th second alternative, a calculation for removal cr its is provided which lowers the amount of t credit by the fraction of time that bypassi occurs. No removal credit can be applied to pollutants such as Cd that accumulate in POTW sludges. In order to continue a removal credit program with EPA approval, the POTW must monitor and report, twice annually, the POTW removal capabilities, a requirement which will most likely lead to changing standards. (Geiger-FRC)
W82-06207

DETROIT-STYLE CSO STUDIES,
Black and Veatch, Kansas City, MO.
M. J. Graham.
Water/Engineering and Management, Vol 129, No 5, p 22-23, 25-26, May, 1982. 4 Fig.

Descriptors: *Combined sewer overflows, Planning, *Storm wastewater, *Storm-overflow sewers, *Overflow, *Detroit, Model studies, Municipal wastewater, Rouge River, Detroit River, Data collections, Michigan.

One of the most comprehensive combined sewer overflow (CSO) studies to date was completed by the Detroit Water and Sewerage Department in the fall of 1980. Data from the study are to be used to calibrate and verify a number of interacting computer models which assess the potential improvement in water quality in the Rouge and Detroit Rivers resulting from overflow control. Five separate models were developed to assess the most cost-effective CSO management alternative. These models were: System, a simplified skeletonized sewer system model with major sewers and interconnections, routed dry weather flow supplemented with storm flow to treatment, storage or overflow; Detroit Sewerage Treatment Plant Simulator, in which effluent quality discharged to the receiving stream was computed based on influent quality and quality from the system model; Rouge River, in which water quality of the Rouge River in various reaches was computed based on fractors of CSO quantity and quality and on background river quality; Detroit River, in which river quality was given based on upstream background, CSOs, Rouge River quantity and quality, and DWWTP effluent; and Detroit River Plumes, which modeled quantity and quality of CSOs from the system to give near-shore quality. The sampling process employed to secure enough data for study was massive. Almost 25,000 individual analyses were entered into the data bank for the system model alone, and an additional 10,000 analyses, including instantaneous flow measurements, were collected for the river models. About 5,000 additional pieces of information on flow and quality were entered for calibration of the treatment plant model. This was probably one of the most comprehensive data collection programs performed for facilities planning purposes. (Baker-FRC)
W82-06247

THE USE OF WATER QUALITY OBJECTIVES IN SEINE-NORMANDIE,
Agence Financiere de Bassin Seine-Normandie (France).
A. Lesouef.
Water Pollution Control, Vol 81, No 2, p 255-265, 1982. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Water quality, *Regulations, *France, Seine-Normandie Basin, Basins, Industrial wastes, Public policy, Public participation, Public opinion.

The Seine-Normandie Basin covers an area of about 96,000 square kilometers and a population of more than 15 million. Industry is important in the basin, with the result that river water quality is affected by both the main cities and industrial activities. With the exception of the sewage treatment plant of Acheres, little was achieved in the way of water quality control until the 1960s. The basin was divided into convenient sub-basins for each of which the following steps were carried out: identification of water use, water quality control, and current water quality assessment. Uses identified included drinking, fishing, swimming and recreation, and industrial usage. Due to its possible consequences on the socioeconomic activities of a particular region, a water quality objective approach should rely on a fair degree of commitment from the public who will have to support its consraints and also benefit from it. Negotiations to establish such a program are long. The different steps of this long process include the preparation of technical files and recommendations, the presentation of the material to administrative services, the presentation of the agreement to a delegated basin commission, presentation of the agreement to a delegated basin commission, presentation to the sub-basin committee, presentation to regional chambers of commerce and industry as well as regional chambers of ariculture, public hearings, summaries of public meetings, proposals to all groups, implementation, and follow-up. Despite the high amount of time and effort needed to follow this long path, it is considered that this approach is worthwhile in France. (Baker-FRC)
W82-06254

LABORATORY SERVICES IN REGIONAL WATER AUTHORITIES,
Anglian Water Authority (England). Scientific Services.
A. W. Davies.
Water Pollution Control, Vol 81, No 2, p 177-184, 1982. 3 Fig, 1 Tab, 1 Ref.

Descriptors: *Water analysis, *Scientific personnel, Personnel, *Laboratories, Research facilities, Water supply development, Water resources development, Chemical analysis, England, Anglian Water Authority.

The importance of laboratories and scientific staff in fulfilling the commitment to provide a wholesome supply of water to the public is considered. There are three basic types of water laboratories: quality control laboratories associated with sewage and water treatment plant operations; laboratories concerned with the mesurement of pollutants in rivers, distribution systems, reservoirs, industrial effluents and dewage, and industrial waste discharges; and central or regional laboratories, whose tasks include inter- and intra-laboratory calibration of methods of quality measurement against standards, the development of new scientific methods to accommodate changing requirements, and the coordination of scientific applications in operational laboratories. The laboratories in the Anglian region during the year 1980 produced about 2.6 million items of information, for which the most important uses include: compliance data representing the analytical results of samples taken of industrial and agricultural consent and unconsented discharges to surface and other waters; operational data to manage a sewage treatment or water supply works efficiently; investigative data required for many different purposes; and administrative data to satisfy national commitments, to answer specific questions, to satisfy water quality directives, and to identify quality trends. Specific responsibilities of the water scientist are listed. Several generalizations are listed which are intended to increase appreciation for the science of water quality. (Baker-FRC)
W82-06256

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
P. Harremoes.
Water Research, Vol 16, No 7, p 1093-1098, July, 1982. 6 Fig, 4 Ref.

Descriptors: *Rivers, *Oxygen depletion, Depletion, Oxygen, Organic matter, Decomposing organic matter, Organic carbon, Sedimentation, Kinetics, Chemical reactions, Fate of pollutants.

A theoretical analysis has shown that removal of organic matter from rivers can adequately be simulated with a first order removal by both extraction and sedimentation, which will fix the organic matter at the bottom. The condition is that the river can be considered vertically well mixed as compared to the rate of removal. It is argued that the removal gives rise to an immediate and a delayed oxygen demand on the river water in

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accordance with the original suggestions made by Velz and Gannon. These phenomena are important for the oxygen depletion experienced in rivers, especially in case of abrupt discharges. Investigation of oxygen depletion generated by a steady-state discharge of partly treated sewage showed a significantly faster removal than can be explained by degradation in the water phase and a significant accumulation of organic matter at the bottom. A simplified theoretical analysis of an abrupt discharge showed that both the immediate and the delayed oxygen consumption can adequately be handled by modifications to the traditional oxygen sag analysis. This analysis shows the extreme importance of making a distinction between the biochemical oxygen demand that will be removed with an immediate oxygen consumption and the fraction that will be removed with a delayed consumption. The final conclusion is that additional study is needed to reveal the importance of this distinction. (Baker-FRC)
W82-06269

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,
For primary bibliographic entry see Field 6E.
W82-06295

GROUND WATER LAW IN PUERTO RICO.
For primary bibliographic entry see Field 6E.
W82-06296

GROUND WATER AND THE STATES,
For primary bibliographic entry see Field 6E.
W82-06297

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,
Verlag Chemie, Weinheim (Germany, F. R.).
For primary bibliographic entry see Field 5C.
W82-06299

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,
Metropolitan Washington Council of Government, DC.
For primary bibliographic entry see Field 6B.
W82-06361

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,
Vermont Water Resources Research Center, Burlington.
E. A. Cassell, D. W. Meals, Jr., and P. Daukas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256652, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 53 p, 25 Tab, 1 Ref, 2 Append. OWRT A-036-VT(2).

Descriptors: *Nonpoint pollution sources, *Public opinion, *Public participation, *Water pollution control, *Surveys, Priorities, Planning, Pollution load, Water pollution sources, Attitudes, Vermont, Public policy, Environmental protection, Resources management, Water management, Management planning, Water conservation, Water quality, Water quality control.

Opinion surveys were conducted in 1978 which were designed to ascertain public perceptions concerning nonpoint source (NPS) pollution, its causes, and its control. The survey results were assessed under two basic public categories: resource operators (farmers, loggers, and buildings contractors) and resource managers (scientists, planners, and resource managers in Vermont local, State, and Federal agencies). The results of the resource operators survey indicated a good general understanding of the NPS pollution problem, and a belief that NPS pollution could be avoided using proper practices. Also expressed was a willingness to help solve NPS pollution, but the lack of technical advice, guidelines, and finances were considered principal deterrents to participation. Results of the resource managers survey identified NPS pollution as an important Vermont issue over the next decade, with major priorities for NPS pollution control being careful problem assessment, basic data collection, public education, and development/implementation of useful conservation practices. Based on the results of these two public surveys, recommendations for enhancing Vermont NPS pollution control are advanced. Individual survey questionnaires used for farmers, contractors, loggers, and managers are included, and the definitive results of the surveys are tabulated. (Zielinski-MAXIMA)
W82-06372

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,
Australian Water Resources Council, Canberra.
Proceedings, Joint United States/Australia Seminar and Workshop, February 19-24, 1979, Melbourne. Australian Government Publishing Service, Canberra 1981. 915 p. Burns, F. L., and Powwling, I. J. (Eds.).

Descriptors: *Destratificatiion, *Thermal stratification, *Water quality, *Lakes, *Reservoirs, *Mixing, Water quality control, International commissions, Lake restoration, Stratification, Turnover time, Density stratification, Lake morphology, Water currents, Environmental quality, Environmental engineering, Environmental effects, Environmental control, Aquatic environment, Hydraulic engineering.

A workshop was convened to discuss destratification and its use to improve water quality in reservoirs and lakes. The proceedings incorporates the 40 papers presented, together with the ensuing discussing and descriptions of field presentations, covering engineering and science efforts in this field in the United States and Australia. The theme is progressively developed from the consideration of the stratified reservoir, through the techiques of destratification, to the consideration of the effects of such action. This is then followed by case studies from the two countries, and culminates in a general discussion bringing together those topics needing further elaboration. The various lake/reservoir mixing projects are also enumerated, with details provided on the methods and equipment used and the results obtained, covering 37 projects. The workshop was undertaken since the two countries cover roughly complementary latitudes north and south of the equator, and since it was felt that the solutions being tried in destratifying thermally-stratified waters would be similar and hence provide a mutual international benefit to advancing the understanding of lake/reservoir destratification approaches. (Zielinski-MAXIMA)
W82-06385

PHYSICAL-CHEMICAL TREATMENT AND DISINFECTION OF STORMWATER,
Ontario Ministry of the Environment, Toronto.
H. Kronis.
Research Report No 88, March, 1982. 112 p, 31 Fig, 30 Tab, 17 Ref, 2 Append.

Descriptors: *Water treatment, *Storm water, *Physiochemical treatment, *Sedimentation, *Disinfection, *Urban runoff, Water quality, Water quality control, Flocculation, Settling basins, Rainfall intensity, Runoff coefficient, Storm runoff, Suspended solids, Water pollution control, Pollutants, Iron, Chemical oxygen demand, Biological oxygen demand, Water analysis, Pollution load.

Urban runoff from a 22.7 hectare (essentially residential) metropolitan Toronto watershed was studied May-October, 1977, and April-July, 1978. Hydrologic events and stormwater quality were characterized, and simple treatment methos (coagulation/sedimentation and disinfection at the bench/pilot-scale level) were applied. Hydrologic parameters (rainfall intensity, runoff, storm sewer flowrates, total runoff volumes/event, antecedent dry periods, runoff coefficients) varied widely. Stormwater pollutant concentrations also varied widely, especially for suspended solids and chemical oxygen demand (COD). Typical average percentage pollutant removals by natural (NS) or chemically-assisted (CA) settling, respectively, for thirteen 1977 storm events were: 88 and 95% (suspended solids); 36 and 68% (BOD-5); 57 and 62% (COD); and 47 and 79% (total phosphorus). For CA settling, alum was the preferred flocculant (30mg/liter, foolowed by at least two hours of quiescent settling); about 10 hours of quiescent settling was estimated to be needed for NS. Indicator bacterial densities in raw stormwater did not vary significantly between events. Disinfection with NaOCl reduced bacterial densities to well below pollution objectives. Of eight trace elements analyzed, only iron levels violated the model industrial waste bylaw. Total phosphorus and nitrogen runoff levels were consistently low and varied little. (Zielinski-MAXIMA)
W82-06389

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237199, Price codes: A02 in paper copy, A01 in microfiche. Report REC-ERC-81-16, November 1981. 19 p, 2 Fig, 7 Tab, 10 Ref, 1 Append.

Descriptors: *Desalination, *Saline water, *Springs, *Water reuse, *Water tretment, *Impaired water quality, Laverkin Springs, Colorado River, Water quality, Water use, Cooling water, Coal slurry pipelines, Deep well injection, Wastewater disposal, Pretreatment of water, Radioactivity, Demineralization, *Utah.

LaVerkin Springs (LVS) are highly saline springs which discharge into the Virgin River (a tributary of the Colorado River) in Washington County, Utah. The high salt content and moderate flow rates significantly contribute to the salinity of the Colorado River. Methods were evaluated for preventing high salinity LVS water from entering the Virgin River and for utilizing the process water in energy development. Analytical water data obtained from a 9-month test program at LVS test site were evaluated. The raw water typically contains 750 mg/l of dissolved carbon dioxide and has a pH near 6.0. It contains the following concentrations in mg/l: 820 of calcium, 150 of magnesium, 1266 of bicarbonate, 1860 of sulfate, 2220 of sodium, and 3345 of chloride. The raw water contains significant amounts of silica, boron, strontium, and sulfide, and a measurable amount of radioactivity. The relative merits of different methods of treatment, disposal, and reuse of LVS water were studied. The disposal of water by deep well injection, use as a secondary coolant in a binary cooling tower, use in solar salt-gradient ponds, and use as a transport media for coal slurry pipelines was found to be technically feasible. Use of LVS water to transport coal to a consuming powerplant and subsequent reuse in a binary cooling tower or solar salt-gradient ponds would achieve both objectives of salt reduction and energy conservation. (Moore-SRC)
W82-06400

HAZARDOUS MATERIAL SPILLS--ARE YOU READY,
East Bay Municipal Utility District, Oakland, CA. Water Quality Div.
K. E. Carns, and K. B. Stinson.
Journal of the American Water Works Association, Vol 74, No 5, p 224-228, May, 1982. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Chemical wastes, *Contamination, *Water supply, *Water pollution sources, Water pollution prevention, Water treatment facilities, Disasters, Water distribution, Waste disposal, Reservoirs, Highways, Oil spills, Protection, Spills.

Water utilities can reduce the disastrous consequences of hazardous material spills on highways and in or near public water supplies by preparing a written response plan and training personnel in emergency procedures. The East Bay Municipal Utility District serving 30 communities east of San Francisco Bay has developed such a plan, which is

composed of five chronological phases: (1) discovery and notification, (2) evaluation and initiation of action (includes notification of public agencies and key utility management personnel), (3) containment and countermeasures (directed by the spill coordinator with help available from CHEMTREC communicator, public notified if necessary), (4) cleanup, mitigation, and disposal (spill is cleaned up promptly, preferably by the spiller), and (5) documentation and cost recovery (written report of the event and assignment of costs). The response procedures are given in outline form, in flow diagram form, and in detailed form. The response plan was tested in two drills of hypothetical events (a tank truck of poisonous chemical sunk in a raw water supply reservoir and pesticide injected into the distribution system). Two actual emergencies in which no water contamination resulted illustrated the value of the plan. These were a spill of transformer oil into a stream and the discovery of several drums of illegally dumped hazardous waste near the district's largest reservoir. (Cassar-FRC)
W82-06417

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 5D.
W82-06455

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,
Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
For primary bibliographic entry see Field 2H.
W82-06473

RUTLAND WATER RAW WATER QUALITY - PROBLEMS AND MANAGEMENT,
Anglian Water Authority, Peterborough (England).
N. F. Low.
Hydrobiologia, Vol 88, No 1-2, p 93-101, March, 1982. 8 Fig, 10 Ref.

Descriptors: *Reservoirs, *Raw water, *Water treatment, Water supply, *Water quality management, Water quality, Land treatment, Sewage effluent, Drought, Reclaimed water, River basin development, Pumping, Pumps, Water quality control, Rutland Water, England.

The options available to control the expected water quality problems in Rutland Water are identified and their use is discussed. Water quality problems result from the eutrophic character of the input waters and from the excessive depth of the reservoir. Two groups of options are available: those which operate on input waters, and those which operate on the stored water. Both types of options will be used, since increased demand for water will result in the reduction of the retention time of the stored water and an increase in nutrient loading. (Titus-FRC)
W82-06475

MODELS OF ANNUAL CYCLES IN LENTIC WATER BODIES,
Salford Univ. (England), Dept. of Civil Engineering.
B. Henderson-Sellers, and P. B. R. Archer.
Hydrobiologia, Vol 88, No 1-2, p 89-91, March, 1982. 4 Tab, 2 Fig, 5 Ref.

Descriptors: *Mathematical models, *Computer models, *Water quality, *Lentic environment, *Stochastic models, *Deterministic models, Calibration, Ecological models, Standing water, Parametric hydrology.

Reasons for modeling water quality are discussed, and a summary of the relevant parameters is presented. The two major types of models, stochastic and deterministic, are described. Stochastic models are those in which elements of the model vary in a random fashion. Inaccuracies are decreased because the input data are not condensed in any way. Results may be more realistic, since they are associated with some degree of uncertainty; however, these models are time-consuming and costly. Deterministic models always produce the same result for a given set of data; they are functional representations of a system. Such models are more economical because they are easier to implement. With any model, a full validation is necessary before any confidence can be placed in the results it produces. Validation involves comparing the computed results with data from previous time periods. (Titus-FRC)
W82-06483

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,
Youngstown State Univ., OH Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 18, No 1 p 81-87, February, 1982. 3 Fig, 28 Ref.

Descriptors: *Mathematical models, *Irrigation, *Management planning, Irrigation design, Irrigation efficiency, Water management, Agriculture, *Salinity, Simulation analysis, Optimization.

Problems which may result from irrigated agriculture in arid and semiarid regions include accumulation of salts, destruction of soil texture, waterlogging, decline in fertility and yield, and eventual abandoning of the land. Many of these problems result from the failure of managers to understand that irrigated land is a system consisting of several interdependent components and that the health of each of these components individually is important to the overall health of the system. The important components of an irrigated system include the quantity and quality of the irrigation water, the quantity and quality of the irrigation return flows, the unsaturated zone, the saturated zone, the water balance of the irrigated system, the salt balance of the irrigated system, and the crop yield. A management model is described which considers each of these nine components in an effort to devise management strategies to halt or at least retard the salinization and waterlogging processes in irrigated agriculture. An optimization model is used to maximize net farm income, encourage conjunctive use of surface and ground water, devise water pumping and application strategies designed to maintain continuous movement of salts out of the system, maintain proper hydrologic balance within the irrigated system, and meet the concentration requirements of the drainage water needed to optimize the yield of individual crops. Simulation models are used to assess the impact of agricultural activities on the unsaturatdd zone and the saturated zone. (Carroll-FRC)
W82-06584

DISPOSAL OF SLUDGE TO SEA,
Oslo Commission (Norway).
For primary bibliographic entry see Field 5E.
W82-06595

NEW PROBLEMS WITH UPLAND WATERS,
Saint David's Univ. Coll., Lampeter (Wales).
D. Kay, and A. McDonald.
Water Services, Vol 86, No 1031, p 29, 31, January, 1982. 27 Ref.

Descriptors: *Landuse, *Catchment areas, Agriculture, *Great Britain, *Research priorities, *Water quality, *Forestry, Elevation, Terrain analysis, Nutrients, Bacteria, Escherichia coli, Enteric bacteria, Watersheds.

In a paper by Youngman and Lack, published in Water Services, 85, (1019), 13-14, 1981, it was suggested that the increased use of upland areas for either lamb production of afforestation will cause problems of nutrient enrichment in catchment streams and impoundments. The direction of research effort suggested by these authors to control the water quality of catchment areas is questioned. Instead of concentrating on upland area nutrient transport, an examination of the microbiological factors involved in water quality is recommended. The investigation of water quality in a multiple-use catchment area in a similar location to areas of pristine moorland is advocated to predict microbiological water quality deteriorations. Monitoring of E. soli levels in Yorkshire catchments has revealed that afforested areas produce lower enteric bacterial concentrations than sheep farming areas. An integrated management approach is advocated which would focus on water quantity and quality, nutrient transport, microbiological deterioration and recreational and agricultural activities. (Geiger-FRC)
W82-06602

A MODEL FOR THE DESIGN OF HYPOLIMNETIC AERATORS,
York Univ., Toronto (Ontario). Dept. of Biology.
C. T. Taggart, and D. J. McQueen.
Water Research, Vol 16, No 6, p 949-956, June, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Design criteria, *Aerators, Hydolimnio, *Aeration, *Wastewater treatment, Oxidation, Model studies, Performance evaluation.

An empirically derived model is presented for use in designing hypolimnetic aerators, which ensures maximum flow efficiency but may not maximize oxygen transfer efficiency. Diffusor depth, air flow rates, rise velocity and cross-sectional area of the riser tube are the major variables considered. Water flow values predicted by the model were correlated with those observed in twenty published field experiments. The model determined that some aerators are inefficient and their design could be improved. A discussion is presented of the required oxygen input during aeration in which the problems of hypolimnetic oxygen depletion rates and oxygen transfer efficiencies are considered. (Baker-FRC)
W82-06610

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,
Texas Univ. at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,
Geological Survey, Denver, CO.
J. T. Turk.
Water Resources Bulletin, Vol 18, No 1, p 75-80, February, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Water quality control, *Thermodynamics, *Mine drainage, Coal mines, Groundwater pollution, Dissolved solids, Chemical precipitation, Geochemistry, *Colorado.

Coal production in Colorado has increased significantly in the period since 1965, raising questions concerning the effects of mine drainage on water quality. Major dissolved ions that contribute to the overall salinity of the water, restricting its suitability for various uses, are frequently found in water from underground coal mines. Thermodynamics provides an effective tool for the assessment of the origin of seepage from underground coal mines and for prediction of compliance with water quality criteria of seepage from other mines within the same geologic formations. Analysis of samples from 13 of the 14 mines studied indicated that calite saturated water had probably reacted with sodium rich marine shales to produce the seepage, which was saturated or supersaturated with respect to calcite. Samples showing evidence of being most completely reacted were composed almost entirely of sodium and bicarbonate ions and had a calcium to sodium activity ratio similar to that of seawater. The one sample not saturated with calcite was saturated with respect to gypsum, probably as a result of simple dissolution of gypsum from the strata through which the groundwater percolated. The primary problems which might result from reuse of the mine drainage would be damage or destruction of crops if the drainage water were used for irrigation. Also, the

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chloride and sulfate concentrations in some samples were in excess of recommended standards for public water supplies. (Carroll-FRC)
W82-06624

THE MATHEMATICAL MODELLING OF WATER QUALITY WITH PARTICULAR REFERENCE TO THE INDUSTRIAL RIVERS OF YORKSHIRE,
Yorkshire Water Authority (England). Directorate of Resource Planning.
P. R. Holmes.
Water Pollution Control, Vol 81, No 1, p 45-58, 1982. 4 Fig, 9 Ref.

Descriptors: *Mathematical models, *Water quality, *Industrial wastewater, Rivers, River flow, River forecasting, Management planning, Water management, Decision making, Water quality management, *United Kingdom.

There has been considerable reluctance in the United Kingdom to use models for river quality management. River modelling studies may be designed to aid river surveillance by interpolating flow and water quality between sampling points to draw attention to inconsistencies in routine data, or to predict future flow and water quality conditions, assuming that present inputs and outputs will remain unchanged except for discrete changes which are to be tested. The main categories of mathematical models are described and compared. The application of mathematical models to practical planning problems in the industrialized river catchments of Yorkshire is examined. This modeling concentrated on steady state mass balance modeling of flow and biochemical oxygen demand, supported by suspended solids and ammonium nitrogen, and using chloride to assist in the balancing due to its conservative nature. The resulting model is basically simple in structure and extensive rather than intensive in its representation of the real river and in its requirements for data. The steady state requirement limits the model to fairly low river flow conditions if catchment-wide modeling is to be conducted. Application of this model to the River Aire catchment is discussed. Data collection and analysis, model calibration, and use of the modeling results in management planning are described. Major deficiencies of the model are examined. It is concluded that this approach to river modeling has provided a simple, economic planning tool for river management. (Carroll-FRC)
W82-06644

A REVIEW OF INDUSTRIAL EFFLUENT CONTROL EXPERIENCE,
Thames Water Authority (England).
P. Brindley, D. C. Carter, and M. J. Linsmith.
Water Pollution Control, Vol 81, No 1, p 59-79, 1982. 20 Fig, 13 Tab, 16 Ref.

Descriptors: *Industrial wastewater, *Water pollution control, Wastewater treatment, Regulations, Water pollution sources, Water quality standards, Effluent limitations, Effluent charges, *Reviews, *Waste assimilative capacity.

Pollution control measures are used to regulate the demands on the assimilative capacity of the environment to be compatible with use requirements. The formation of water authorities in the United Kingdom in 1974 led to considerable standardization of the diverse control and charging systems previously used to regulate industrial effluents. The general procedures used in the Chiltern Division of the Thames Water Authority in developing consent agreements with respect to effluent discharges with individual companies are described. The steps taken in the establishment of an industrial waste treatment plant, and the limitations placed on that plant, are outlined. These limitations included limitations on wastes to be treated, effluents, and plant operations. The Thames Water Authority has also established a catchment quality control function to assess and, where possible, control the extent and nature of continuous contamination of lowland water resources with persistent chemicals. The methods used to achieve these goals are described. The factors which determine the industrial effluent limits are directly associated with the quality objectives of the products of sewage treatment. Metal standards relating to sludge applied to land and to river water quality have become more precisely defined since 1970. Since all treated sludges in the Chiltern Division are distributed to land for agricultural purposes, standards for industrial effluents contributing to these sludges have also become more strict. Industrial effluent testing procedures are discussed briefly. (Carroll-FRC)
W82-06648

THE CONTROL OF EFFLUENT AND WATER QUALITY IN AN IMPORTANT WATER SUPPLY CATCHMENT,
Severn-Trent Water Authority (England). Derwent Div.
K. Selby, and T. D. A. Tricker.
Water Pollution Control, Vol 81, No 1, p 97-111, 1982. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Water quality control, *Water quality management, *Catchment areas, River catchments, Water supply, Industrial wastewater, Water pollution control, Effluent limitations, Wastewater treatment, *United Kingdom, River Derwent.

The River Derwent in Derbyshire is one of the most highly utilized water-supply rivers in the United Kingdom and has a finer resource/demand balance than most rivers. The Severn-Trent Water Authority has had responsibility for the control of effluents and for water quality in this catchment since 1974. The River supplied significant quantities of water to textile and other industries in the district and is used extensively for recreational pursuits. A high proportion of the river flow is used water, much of which is derived from industry. The Authority's Directorate of Scientific Services is responsible for water quality control functions, which include the control of effluents from sewage treatment works and industries discharging directly to a watercourse, the protection of underground water resources, and the monitoring of the quality of water supplies. The issue and enforcement of consents to discharge are the major means used to protect the quality of surface and ground water resources. River water quality objectives for the catchment are presented, and efforts being made to achieve these objectives are discussed. The industrial discharges, and private septic tank systems on water quality and efforts being made to minimize their impacts are described. Water quality problems particular to the River Derwent include pollution emergencies, high dissolved oxygen concentrations, damage to sewage treatment processes due to the high proportion of industrial effluents in the sewage, problems with color due to the large number of textile effluents, problems with organic micro-pollutants related to industrial wastewaters, and organoleptic problems in water supplies. Sources of these problems and methods being used to ameliorate them are discussed, (Carroll-FRC)
W82-06652

A WATER QUALITY INDEX FOR LAKE BEACHES,
Eco-Recherche Ltd., Pointe-Claire (Quebec).
N. St. Louis, and P. Legendre.
Water Research, Vol 16, No 6, p 945-948, June, 1982. 2 Fig, 2 Tab, 10 Ref.

Descriptors: Water quality, Recreational facilities, Bacteria, *Coliforms, *Streptococci, Beaches, Lakes, Lake beaches, *Bacterial analysis, *Pollutant identification.

A water quality index was developed, based on total and fecal coliforms and streptococci concentrations. A linear combination of these three bacterial variations was sought, thus making it possible to weight them differentially. The index described results from the comparison of a group of beaches, all in the same area and subjected to similar uses. A total of 5651 samples were obtained from 42 sampling stations on 7 beaches and analyzed for bacterial concentrations. The study period was 10 years. Discriminant analysis of the data led to a cononical vector accounting for most of the variability of the three microbial count variables recorded. This discriminant axis ordered the beaches along a cline of increasing pollution. It is then transformed into a microbial water quality index calibrated for the given set of beaches, which is in turn used to study the medium-term variability and the long-term evolution of water quality of the beaches. (Baker-FRC)
W82-06660

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W82-06663

STATUS OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 8G.
W82-06665

EVALUATION OF EFFECTS OF STORMWATER DETENTION IN URBAN AREAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256736, Price codes: A07 in paper copy, A01 in microfiche. Report, May 1982. 139 p, 24 fig, 7 Tab, 48 Ref. OWRT B-244-TEX-(1), 14-34-0001-1267.

Descriptors: *Storm water, *Urban areas, *Computer models, *Watersheds, *Detention reservoirs, Mathematical models, Mathematical studies, Model studies, Land use, Ponds, Storm runoff, Storm surges, Urban runoff, Catchment areas, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, Flood peak, Storage reservoirs, Suspended solids.

Research was carried out to assess stormwater detention effects on water quality and flood control in urban ares using computer models and measurement data. The technical efficiency of pollutant removal and flood control were measured and modeled for several existing pond systems. Further, stormwater management alternatives were defined at the watershed level, based upon detention storage analysis and watershed modeling. A developed optimum scheme is described for locating detention ponds within urban areas. In addition to the development of management alternatives, economic feasibility and implementation needs were examined at the subdivision aad watershed level. It was concluded that maximum hydrologic input due to full urban development of a 1 sq mile catchment occurs between a 50-75% development phase, accounting for about 40% of the flow increase for peak flows. Detention storatge land requirements at the catchment level for reducing peak flows to undeveloped levels range from 6% of the load area (for a 10-ft outfall depth) to 16% (4-ft outfall). Model results for locating detention storage throughout a 10-mile watershed indicate no need for any storage at the most down stream pond system was found efficient for suspended solids removal (1200 mg/liter inflows reduced to 100 mg/l at outflows) over a range of storm flows and durations. (Zielinski-MAXIMA)
W82-06698

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),
Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
For primary bibliographic entry see Field 6F.
W82-06714

50 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (50 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER

WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
P. Koppe, K. H. Kornatzki, E. A. Nusch, F. Dietz, and G. Reinnarth.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 17-29, January, 1982. 9 Fig, 13 Tab, 26 Ref. English summary.

Descriptors: *Lakes, *Lake sediments, *Ecosystems, *Nitrification, Ecology, Hydrology, Denitrification, *West Germany, Lake Baldeney, Nitrogen fixing bacteria, Mineralization, Sediments, Lake morphology, Limnology, Artificial lakes, Ruhr River, Water resources development, Aeration, Dredging, Heavy metals, Pollutants, Water quality.

Lake Baldeney, an impoundment of the Ruhr river in West Germany, is a hydrological hybrid which can be described in a simplified form as a double-channel two-layer model. The layers comprise a shallow lentic area with a low speed of flow and thick sediment layer and a deeper lotic area in which flow speed is significantly higher and almost no sediment is deposited in some spots. The mineralization of sediment from the lentic zone and the reduction in organic material in solution show that the lake is highly capable of water purification. Heavy metals are also deposited in the lake, whence they can be removed by dredging. Denitrification processes and the release of ammonia (mostly from sediment) also influence water quality. When a sudden high pollution load occurs (e.g. through a heavy rainstorm) the lake acts as a buffer. The nitrification rate is significantly higher at the inflow to the lake than at the outflow; this is attributable to a reduction in the number of nitrifying bacteria, probably because they adhere to suspended solids which are deposited in lake sediment. Gas exchange (nitrogen, carbon dioxide, oxygen) with the atmosphere cannot be measured accurateley, as the sediment acts as a store for organic and inorganic material as well as producing its own organic material. Research should therefore be performed on the interaction between sediment, suspended solids and water as well as on ecological interactions within the biological community. Lake Baldeney should be monitored constantly and aeration should be performed when oxygen metabolism so demands. Dredging will eventually be necessary due to continuing sedimentation. (Gish-FRC)
W82-06716

CALCULATING CONSENT CONDITIONS TO ACHIEVE RIVER QUALITY OBJECTIVES,
Anglian Water Authority (England). Dept. of Operational Planning.
A. E. Warn.
Effluent and Water Treatment Journal, Vol 22, No 4, p 152-153, 155, April, 1982. 12 Ref.

Descriptors: *Water quality standards, *Effluent standards, *River regulations, Water quality control, Standards, Regulations, Flow regulation, *Monte Carlo method, Sampling, Errors.

River Quality Objectives (RQO) are defined as the river quality needed to protect the intended uses of rivers. Their purpose is to ensure a proper allocation of resources to problems of river quality. Methods for calculating consent conditions to use in RQO are discussed. The Combining Distributions Methods (CD) are analytical solutions. They are simple to use and can be done on a programmable calculator. The Monte Carlo Method or Simulation Method requires more computer resources, but can be applied to a wider range of problems. The disadvantages of the simple mass balance equations are shown, for example, the adoption of unachievable RQO and underestimation of the self-purification capability. Use of the CD or Monte Carlo methods shows that river flow regulation is a senseless way of achieving river quality objectives. (Cassar-FRC)
W82-06725

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
For primary bibliographic entry see Field 5C.
W82-06733

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,
Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5F.
W82-06769

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
R. Field.
Water Research, Vol 16, No 6, p 859-870, June, 1982. 19 Fig, 2 Tab, 33 Ref.

Descriptors: *Combined sewers, *Reviews, *Storm-overflow sewers, Sewers, Storm water, Storm runoff, Retention basins, Catchbasins, Flushing, Design criteria, Polymers, Infiltration, Storage.

A state-of-the-art assessment is made of the activities of the Environmental Protection Agency's Storm and Combined Sewer Program over the past 15 years. The topics relate to collection systems and in particular to the management of collection systems for the dual purposes of drainage and pollution control, along with maintenance of such systems. Specific topics touched upon include catchbasins, new sewer design, sewer flushing, polymer injection, infiltration/inflow controls (Insituform, impregnated concrete pipe, and trenchless sewer), upstream storage/attenuation, flow routing and in-pipe storage, new types of flow regulators (swirl and helical bend regulator/concentrators, fluidic regulator, and hydrobrake), and new tide gates. In many cases where revision is necessary, the emphasis is placed upon optimal utilization of the existing facilities. (Baker-FRC)
W82-06775

LAKE RESTORATION BY SEDIMENT REMOVAL,
Corvallis Environmental Research Lab., OR.
S. A. Peterson.
Water Resources Bulletin, Vol 18, No 3, p 423-435, June, 1982. 5 Fig, 88 Ref.

Descriptors: *Sediment control, *Lake restoration, *Lake sediments, Sedimentation, Sediments, Dredging, Eutrophication, Phosphorus, Nutrients, Macrophytes, Aquatic plants, Cost analysis, Water quality.

Information on the effectiveness of sediment removal as a lake restoration technique is updated. Sediment removal is usually undertaken to deepen a lake and increase its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. In reviewing more than 60 projects and five case histories, it is revealed that the first three objectives are usually met through sediment removal. Dredging to control aquatic plants has not been well documented. Disadvantages of dredging include cost, temporary phosphorus release from sediment, increased phytoplankton productivity, noise, lake drawdown, temporary reduction in benthic fish food organisms, potential for toxic material release to the overlying water, and potential for environmental degradation at the dredged material disposal site. The technique is recommended for deepening and for long range reduction of phsophorus release from sediment. Sediment removal to control toxic materials is possible with minimal environmental impact when proper equipment s used, but it may more than double the cost. Lack of definitive information about rooted plant regrowth rates in dredged areas prohibits explicit recommendations on sediment removal to control plant growth. (Baker-FRC)
W82-06776

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,
West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.
For primary bibliographic entry see Field 5C.
W82-06777

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
For primary bibliographic entry see Field 6B.
W82-06778

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06789

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),
Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W82-06825

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,
Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W82-06827

EFFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,
Allahabad Univ. (India). Dept. of Chemistry.
For primary bibliographic entry see Field 4D.
W82-06834

STORMWATER MANAGEMENT IN A SENSITIVE AREA.
Public Works, Vol 113, No 7, p 67, July, 1982.

Descriptors: *Water management, *Saline water intrusion, *Storm water, Water quality management, Nutrient removal, Environmental effects, Jonathan's Landing, *Florida, Mangrove swamps, Water level, Storm wastewater.

The water management system at the 600-acre Jonathan's Landing, Florida, development has been called a model system. Major challenges in this golf-oriented, environmentally sensitive area were preserving the mangrove ecosystem, creating a 120-acre system of interconnecting fresh water lakes and tidal channels while preventing salt water intrusion, controlling storm water runoff pollutants, and preserving the esthetic appearance of the system. The water control structures include wells to manipulate fresh water levels, monitoring wells to detect shifts in the fresh water/salt water interface, and a broken tile filtration system to control nonpoint source pollution (nutrients and particulates removed by a system of grass swales). (Cassar-FRC)
W82-06841

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,

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Plainville Water Co., CT.
L. E. Bordeau, and G. P. Fulton.
Public Works, Vol 113, No 7, p 72-73, July, 1982. 2 Fig.

Descriptors: *Water pollution treatment, *Organic compounds, *Wells, Groundwater pollution, Municipal water, Plainville, *Connecticut, *Chlorinated hydrocarbons, Industrial wastes, Water pollution sources, Fate of pollutants.

The Plainville Water Company, Connecticut, relying on two well fields, detected organic chemical pollution of its newer well field in 1975. Trichloroethylene levels were over 400 ppb; trichloroethane, 1000 ppb; and chloroform, 600 ppb. The source of the contamination, waste industrial solvent from an industrial park adjacent to the well field, was located and dumping stopped immediately. The aquifer was purged by pumping the more severely contaminated well to a waste collection area. Chloroform levels, used as an indicator, dropped to below 30 ppb by July 1975, below 10 ppb for most of 1976, and below 1 ppb by the middle of 1977. Levels of trichloroethylene and trichloroethane paralleled those of chloroform. (Cassar-FRC)
W82-06842

WATERTIGHT MANHOLES CUT INFLOW.
Public Works, Vol 113, No 7, p 52, July, 1982.

Descriptors: *Waterproofing, *Rehabilitation, *Sewer systems, Plastics, Infiltration, Manholes, Hitchcock, *Texas.

Sewer Guard water tight manhole inserts are being installed in the Hitchcock, Texas (population 6000) sewer system as part of a $8 mission wastewater system rehabilitation. The disk-shaped plastic inserts, resistant to corrosion and damage by sewer gas or road oils, form a virtually leakproof seal with the manhole frame. There are two self-cleaning relief valves. Sealed manholes effectively prevent inflow of storm water and debris. This is especially important in low-lying areas where water stands for some time after a storm. Groundwater infiltration is prevented by brushing two coats of waterproofing compound onto the manhole surface, starting at the top and working down to the invert shelf. (Cassar-FRC)
W82-06844

THE CHALLENGE OF UPGRADING ROADSIDE REST AREAS,
Iowa Dept. of Transportation, Ames.
H. Dolling.
Public works, Vol 113, No 7, p 50-51, July, 1982.

Descriptors: *Rehabilitation, *Recreation, *Roads, Sanitation, Highways, Wastewater treatment, Wastewater lagoons, Lagoons, *Iowa.

Iowa rehabilitated four pairs of the 19 and 1/2 pairs of rest areas on its interstate system during 1979-80. Originally built in 1966, the rest stops were inadequate for today's traffic. Costs for reconstruction were about $1 million for each pair of rest stops. Wastewater lagoon improvements at the first stop to be rehabilitated cost nearly $200,000. Some of the problems facing engineers were: poor surface drainage at the flat sites, freezing of wastewater transmission lines, and sidewalk heaving in the heavy clay soils. A grinder pump was installed to move recreation vehicle wastewater in one rest area. Some toilets were replaced with low water volume fixtures. Lagoon improvements were deferred until more funds are available. (Cassar-FRC)
W82-06845

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,
Hawaii Inst. of Marine Biology, Honolulu.
S. V. Smith, W. J. Kimmerer, E. A. Laws, R. W. Brock, and T. W. Walsh.
Pacific Science, Vol 35, No 4, p 279-395, October, 1981. 52 Fig, 51 Tab, 142 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, Marine biology, *Kaneohe Bay, *Hawaii, Diversion, Nutrient cycling, Phytoplankton, Zooplankton, Nitrogen, Phosphorus, Detritus, Heterotrophs, Benthos, Biomass, Water pollution effects, Subtropical regions, Bays, Nonpoint pollution sources, Fish, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Sediments, Lagoons, Reefs, Corals.

Domestic sewage secondary effluent entering Kaneohe bay, Hawaii, was diverted to the ocean in December 1977 (municipal) and May 1978 (Marine Corps) to study the responses of the ecosystem to sewage diversion. Nitrogen was the limiting nutrient. All of the inorganic N and most of the inorganic P added to the system were taken up biologically, mostly by phytoplankton. The rapid rate of nutrient cycling between the dissolved state, phytoplankton, zooplankton, microheterotrophs, and detritus supported a rate of productivity far exceeding the rate of nutrient loading. The nutrients reaching the benthos produced a large increase in detritivorous heterotrophs. The benthic community biomass was controlled by particulate loading. In the benthos the nutrients cycled among the dissolved state, heterotrophs, autotrophs, and the detritus. Eliminating the sewage input rapidly reduced biomass of plankton and benthos. Responses of variables to diversion fell into three groups: (1) moderate diversion and spatial responses (dissolved inorganic N, particulate organic carbon, phytoplankton biomass, phytoplankton growth rate, macroplankton dry weight, microplankton ash-free dry weight, lagoon floor N release, and extinction coefficient); (2) large diversion and wide range of spatial responses (dissolved inorganic P, hard bottom algal biomass, hard bottom cryptofaunal biomass, and lagoon floor biomass); and (3) little diversion and slight-to-large spatial responses (detritus, zooplankton, benthic algae and macrofauna, and fish). The benthic community did not return to the presewage state by the end of the study in August 1979, partly because some of the key organisms are long-lived and partly because nonpoint pollution sources continue to add sediment and runoff. (Cassar-FRC)
W82-06846

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,
Pittsburgh Univ., PA. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06881

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06892

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
E. Cover, and J. Wilhm.
Hydrobiologia, Vol 87, No 1, p 11-16, February, 1982. 3 Tab, 24 Ref.

Descriptors: *Destratification, *Lakes, *Metals, Manganese, Iron, Zinc, Heavy metals, Water sediments, Mixing, Ham's Lake, *Oklahoma, Benthic fauna, Accumulation, Bioaccumulation, Lake restoration, Fate of pollutants.

Water and sediment samples were collected from a destratified section and from a stratified arm of Ham's Lake, Oklahoma, in the spring, summer, and fall of 1978 and 1979. Total Mn in water was 38-119 micrograms per liter in spring and fall for both stratified and unstratified stations. However, in summer total Mn in water ranged from 109 to 5510 micrograms per liter, highest in the hypolimnion of the stratified arm. Soluble Mn comprised 8-65% of the total, average 28%. Mn in sediments ranged from 140 to 1562 micrograms per g with highest concentrations in summer and fall. Macroinvertebrates contained 39-1039 micrograms Mn per g, but variations between stations were not significant. Mean iron concentrations were: water (total Fe), 158-661 micrograms per liter; water (dissolved Fe), 16-176 micrograms per liter; sediments, 2-7 micrograms per g; and invertebrates, 544-6226 micrograms per g. Zn levels were very low in water (6-21 micrograms per liter) and sediments (0.5-1.4 micrograms per g). Concentration factors for Chaoborus punctipennis and Chironomus riparius were: Mn, less than 1; Fe, 1021 and 5111, respectively; Zn, 658 and 920, respectively. (Cassar-FRC)
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W82-06899

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,
Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
W. H. O. de Smet.
Hydrobiologia, Vol 87, No 2, p 171-189, 1982. 11 Fig, 10 Tab, 32 Ref.

Descriptors: *Ponds, *Aeration, *Midges, *Aerated lagoons, Oxidation, *Belgium,, Water pollution effects, Mud, *Phallus process.

An aeration system based on the principle of the water jet vacuum pump (Venturi system, Phallus process) was used to aerate a lowland brook-pond system polluted by organic waste. The effect of this aeration on immature chironomids was investigated. Forty-two species or species groups were found. A total of 224 samples were taken from 70 sampling stations. The changes in community composition, species richness, diversity, redundancy, abundance and biomass were studied in the light of the recovery after treatment. Before aeration started, chironomids were absent in the aeration basin. After 8.5 months of aeration a chironomid community characterized by low species richness (four species) and high redundancy was established. Prolonged aeration resulted in a further increase of the species diversity, and during the last survey, after about 2 years of aeration, the chironomid species richness had increased to 18 species. Similar trends could be found for the downstream sampling stations. The longitudinal recovery pattern probably restored the original zonation of the chironomid species, resulting from an ecological gradient created by the linear change in physiography of the water body. Orthocladiinae dominated in the brook stretch, whereas Chironominae and to a lesser extent Tanypodinae dominated in the ponds. (Baker-FRC)
W82-06912

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,
Belorussian State Univ., Minok (USSR).
For primary bibliographic entry see Field 5C.
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).

For primary bibliographic entry see Field 5C.
W82-06987

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 7, p 68-69, July, 1982. 1 Fig.

Descriptors: *Safety, *Personnel, *Accidents, Wastewater treatment, Education, Management, Attitudes, Williamsport, *Pennsylvania.

The Williamsport Sanitary Authority, Pennsylvania, established a safety program in 1980. The plan consisted of five basic components: (1) a review of common causes and types of wastewater accidents (obtained from experienced employees, reports at safety meetings, literature, correspondence, the accident file, and job site inspections), (2) promotion of a safety awareness effort (through the safety coordinator, bulletin board, safety meetings, and literature), (3) motivation of employee attitudes and participation (by bonuses, personnel evaluation, awards, photographs, safety meetings, literature, and memberships in safety organizations), (4) education and instruction of employees in safe work practices (by audiovisual material, drills, job site inspections, required reading and tests, good housekeeping, and safety meetings), and (5) acquisition and maintenance of safety equipment. The safety program, originated by management, has been taken over by the employees, who also organized existing safety notes into a 25-page booklet for distribution among workers. (Cassar-FRC)
W82-06992

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
J. Stedinger, D. Pei, and T. Cohn.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 508-511, June, 1982. 68 Ref.

Descriptors: *Literature reviews, *Systems analysis, *Water quality management, *Model studies, *Reviews, Monitoring, Water Pollution control, Wastewater treatment, Water reuse, Optimization, Nonpoint pollution sources, Planning, Water management, Water quality, Wastewater renovation.

Applications of systems analysis to water management were reviewed under several categories: water quality management, water quality assessment, pollution control, water quality modeling, and wastewater treatment and reuse. Water quality management topics concerned improvement of both public welfare and private profit through pollution control, methods for estimating stream assimilation capacities and waste load allocations, and effluent charges. Water quality assessment models were devised which linked pollution sources at the county level with major water bodies and which investigated the impact of energy production on water quality. Water quality control planning should consider all possible alternatives, marginal costs and benefits, seasonal variations in assimilative capacity, Nonpoint pollution sources, and use of reservoir releases. Water quality modeling methods were developed and improved with respect to urban storm water pollution, calibration and verification of models, proper sampling programs, phosphorus in lakes, and thermal and other discharges from powerplants. Models for wastewater treatment and reuse included a multilevel optimization model for multiobjective, multiprocess wastewater treatment problems, optimization of a 6-unit wastewater treatment plant subject to designated constraints, minimizing operations and maintenance costs, fault tree analysis for monitoring of small unattended plants, and water reuse planning. (Cassar-FRC).
W82-06997

ECONOMICS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
J. C. Hite, and R. K. McConnell.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 511-513, June, 1982. 19 Ref.

Descriptors: *Literature reviews, *Economic aspects, *Water quality management, *Cost-benefit analysis, Benefits, Urban runoff, Agriculture, Nonpoint pollution sources, *Reviews, Agricultural runoff, Taxes, Water pollution control.

Economists contributed a diverse body of information to the recent year's literature on water quality. Articles ranged from technical analysis of cost structure in water-using industries to studies on the effect of alternative pollution control policies on regional economies. Several studies concerned the economic aspects of nonpoint source pollution in agriculture and urban areas. Complex interrelationships between environmental quality regulations, farm price support and export policies, and farm income led to the conclusion that national policy on agricultural non-point-source pollution must be integrated with agricultural price and production policies to achieve success. Cost effectiveness, information and administrative costs, associated effects and acceptability of control options were considered for non-point-source pollution control in urban areas. Quantifying costs and benefits of water quality improvement was documented in several cases. Cost-effectiveness of meeting standards in wastewater systems, both municipal and industrial, was discussed. Several authors stated that economic incentives and pollution taxes are ineffective in water quality management. (Cassar-FRC)
W82-06998

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DEVELOPMENT OF MODELS FOR THE PLANNING OF LARGE-SCALE WATER-ENERGY SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
J. Matsumoto, L. W. Mays, and G. A. Rohlich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243395, Price codes: A15 in paper copy, A01 in microfiche. Technical Report CRWR-187, January 1982. 321 p, 34 Fig, 17 Tab, 37 Ref, 8 Append. OWRT B-231-TEX(2), 14-34-0001-0251.

Descriptors: *Energy, *Mathematical models, *Water demand, *Future planning, *Economic aspects, Fuel, Water use efficiency, Water requirements, Algorithms, Model testing, Forecasting, Prediction, Projections, Mathematical studies, Model studies.

A mathematical optimization model was developed to assist the investigation of various alternatives for future water-energy systems. The capacity expansion problem of water-energy systems considers future water-energy demands (for water, electricity, gas, coal) and the availability of water and coal, and requires the determination of the location, timing, and size of facilities to satisfy demands at minimum cost (including operating and capacity costs). The system consists of four subsystems (water, coal, electricity, and gas), the interactions of which are novelly expressed explicitly in mathematical terms and equations. Decomposition techniques are extensively applied because of the large scale nature of the problem. To accomplish this, an in-depth study was made of the mathematical structure of the problem. Benders decomposition was applied to the problem, decomposing it into a three-level problem: the capacity, production, and distribution sub-problems. These sub-problems were solved by the use of special algorithms: the generally upper-bounded, the simply upper-bounded, and the generalized network flow algorithms, respectively. Model uniqueness characteristics, major accomplishments towards solving the water-energy problem, comparisons with the other models, and suggested further work are described. (Zielinski-MAXIMA
W82-05915

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 4A.
W82-05925

MULTIOBJECTIVE RIVER BASIN PLANNING WITH QUALITATIVE CRITERIA,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
M. Gershon, L. Duckstein, and R. McAniff.
Water Resources Research Vol 18 No 2, p 193-202-, April, 1982. 4 Fig, 8 Tab, 21 Ref.

Descriptors: *Management planning, *Mathematical models, *River basin development, Water resources development, Resources development, Planning, Environmental impact, Resources management, Mathematical studies, Model studies, River basins, Water use, Semiarid climates.

The ELECTRE I and II methodologies were applied to multiobjective water problems in a semiarid environment. A multicriterion viewpoint was used to assess the impact of alternative river basin strategies on the Santa Cruz River in the vicinity of Tucson. Alternatives were ranked by the ELECTRE I method to obtain preference graphs to use as input into ELECTRE II. A complete ordering system based on quantifiable and nonquantifiable ordinal criteria was generated which allowed different weights to be assigned to different criteria to affect the outcome of results. In the case study presented, the preferred systems to solve water use conflicts of urban, agricultural, Indian and mining interests were reservoirs and channelization, while the least preferred solutions included areas of groundwater development. (Geiger-FRC)
W82-06062

A MULTIOBJECTIVE BRANCH-AND-BOUND METHOD FOR PLANNING WASTEWATER AND RESIDUAL MANAGEMENT SYSTEMS,
Kentucky Water Resources Research Inst., Lexington.
M. Nakamura, and S. M. Alexander.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243643, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 130, January 1982. 109 p, 21 Fig, 7 Tab, 136 Ref, 3 Append. OWRT A-083-KY(1). 14-34-0001-0119/1119.

Descriptors: *Multiobjective planning, *Algorithms, *Wastewater management, *Management planning, *Water costs, Planning, Mathematical studies, Optimization, System analysis, Mathematical analysis, Network design, Regional analysis, Regional planning, Numerical analysis, Wastewater, Mathematical equations.

A multi-objective branch-and-bound (BOB) algorithm method is proposed for use in analyzing multi-objective fixed-charge network-flow problems commonly found in water resources planning situations. A multi-objective imputed value analysis is also proposed, which makes use of the BOB tree-structure and allows comparison of the importance of facilities in the network. The imputed values obtained for a given problem provide information difficult to obtain efficiently using conventional mathematical optimization techniques. The method is capable of systematically and efficiently identifying a set of good planning alternatives. The method was applied to two hypothetical example problems dealing with regional wastewater treatment and residual management systems to demonstrate its potential usefulness. While the proposed method is designed to deal with network-flow structured problems, application of the BOB concept to general mult-objective planning analysis itself is appealing. The BOB tree can be extended to any desired set of objective cut-off values, and a set of noninferior solutions can be identified among the generated alternatives. The mathematical for-

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mulation and the analysis procedure of the method was described. (Zielinski-MAXIMA)
W82-06149

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
J. L. Findeis, and N. K. Whittlesey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243718, Price codes: A12 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Report 44, May 1982. 257 p, 3 Fig, 77 Tab, 91 Ref, 6 Append. OWRT A-100-WASH(1), 14-34-001-9051.

Descriptors: *Model studies, *Input-output analysis, *Cost analysis, *Economic impact, *Irrigation requirements, *Hydroelectric power, Computer models, Mathematical models, Mathematical studies, Economic aspects, Economic evaluation, Water use, Electric power rates, Electric power costs, Thermal power, Irrigation, Irrigation water, Water demand, *Washington.

Research was carried out to analyze the competitive relationship between irrigation and hydropower uses of water, and to determine the impact of irrigation development on economy for the State of Washington. Estimations of irrigation and hydro-generation trade-offs were made using an updated version of the 1972 Washington State input-output model. Two irrigation projects were chosen for study, encompassing 796,000 acres. Undertaking both projects would yield an estimated additional agricultural output of $209 million/year (1972 prices), but substantially electrical losses for irrigation energy and energy lost through water diversions would occur. Replacing this power by thermal power would increase State wholesale electricity rates by as much as 43% above 1980 levels. Input-output analysis measured statewide impacts of simultaneous electricity rate and agricultural output impacts and assessed the distributional effects of additional irrigation. Even with higher electricity rates, State output, employment, and income will increase due to irrigation development, but distributional impacts will be significant. Undertaking both projects, residential electric bills will increase $11.36/person/year and certain industries will experience net residual income losses ($18 million/year for the aluminum industry alone at 1972 dollars. (Zielinski-MAXIMA)
W82-06156

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06175

RESERVOIR PLANNING FOR BRAZILIAN DAMS,
Brazilian National Committee on Large Dams; and Technical Commission on Dams and the Environment.
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 34, No 5, p 48-49, May, 1982.

Descriptors: *Multipurpose projects, *Reservoirs, *Water resources development, Planning, Brazil, Dams, Institutional constraints, Water law, Hydroelectric power, Developing countries.

Brazil's Codigo das Aguas, a collection of laws relevant to water resources, was compiled in 1934, before the industrial and population explosion and before large-scale water resources development. Pollution control regulations are still in an initial phase. Hydropower development is the responsibility of Electrobras, the federal holding company. Permits for construction of dams must be obtained from the Ministry of Mines and Energy. To date most reservoirs built in Brazil have been single-purpose. Little regional planning was done until 1979, when the federal government established a special committee on integrated watershed studies. This is responsible for regional planning and multipurpose development of streams and rivers. Increasing numbers of dam owners and designers favor multipurpose uses of reservoirs. Planning is done in three stages: (1) a baseline survey of hydrology, geology, biota, water quality, social impact, economic impact, etc., (2) appraisal of environmental effects, and (3) actual planning phase. (Cassar-FRC)
W82-06206

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 4A.
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
For primary bibliographic entry see Field 4A.
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06433

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,
Missouri Univ., Kansas City. Dept. of Geosciences.
S. E. Hasan, and T. R. West.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 117-132 1982. 7 Fig, 9 Tab, 15 Ref.

Descriptors: *Land use planning, *Geology, *Decision making, Maps, Planning, Computers, *Indiana, Waste disposal, Solid waste disposal, Septic tanks, Soil types, Bedrock, Soil classification, Erosion, Flood data, Water table, Permeability, Zoning, Data interpretation, Groundwater, Surface water, Networks, Data requirements.

A computerized data base for land use planning at the county level was developed using Boone County, Indiana, as the study area. The purpose of the work was to select the physical characteristics that best describe the land for planning purposes and to select the optimum size of the data cell. After the physical characteristics (or variables) were selected, the relative importance of each was evaluated. The subcategories of each variable were then ranked in order or importance. Computer processing assigned a weighting for each data point for a specific land use. The 23 variables included soil type, slope class, erosion class, flood potential, drainage class, depth to seasonal high water table, permeability, and agricultural productivity. A sample problem determined the suitability of a site for solid waste disposal. The solution was produced in the form of a computer generated map. The optimum cell size, dependent on the scale of the original data and the scope of planning, was 500 ft on a side for this study. The differences between results from smaller cells (250 and 100 ft on a side) were not great, but the data requirements of the smaller cells are much greater. (Cassar-FRC)
W82-06552

6B. Evaluation Process

WATER CONSERVATION INCENTIVES AND STRATEGY,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
For primary bibliographic entry see Field 3D.
W82-05906

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243338, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 142, June, 1982. 24 p, 17 Ref. OWRT A-059-IND(1).

Descriptors: *Irrigation economics, *Cost analysis, *Subsidies, *Arid areas, *Humid areas, Irrigation, Irrigation water, Public policy, Water policy, Corn.

The objectives of the research presented in the report was (1) to measure the marginal product of water in the production of corn in arid and humid regions of the United States and (2) to suggest implications of this analysis for public policy decisions in the future. The analysis involved estimations of production functions for irrigated corn in several states based upon agronomic data from experimental test plots. Alternative functional forms were examined and the three-halves polynomial function was selected to compare the marginal products among the states. The results indicated differences exist among states in the maginal product of water in corn production. Since these differences are not directly related to the areas where irrigation development has been publicly financed in contrast to privately supported, future public policy should take that into consideration. Policy options should include alternative subsidy programs for irrigation water supply systems, policies to influence the price of inputs other than water, policy to adjust the price of corn and elimination of all public support of irrigation development. The results of the analysis are limited by considerations of the marginal products of other crops and the marginal product of water in other uses. Neither of these issues were examined in this study because the research concentrated upon the single crop of corn which is grown and irrigated in many regions of the United States. (Author abstract)
W82-05909

HYDROELECTRIC POWER OFFERS STABLE, CHEAP ENERGY SOURCE FOR INDUSTRY,
Parsons, Brinckerhoff, Quade and Douglas, Inc., New York.
B. J. Van Weele, and E. M. McClung.
Pulp and Paper, Vol 56, No 2, p 114-115, February, 1982. 3 Fig.

Descriptors: *Hydroelectric power, *Pulp and paper industry, Economic aspects, Design criteria, Construction.

The pulp and paper industry is in a unique position to capitalize on hydropower, as many of the existing sites were selected and developed for this purpose by pulp and paper companies more than a century ago. Several economic considerations of hydropower development from the viewpoints of both new construction and the rehabilitation of abandoned sites are described. The best hydroelectric power plant sites tend to be located in forested areas with streams. The major advantage of a hydrosite to the developer is that it constitutes a long term energy source. Initial development cost may be high, but maintenance costs will be low, and the costs of energy production will rise less rapidly than the prices of energy from most other sources. The hydropower site also includes as advantages pollution free operation and no waste disposal problems. Four types of sites are likely to be candidates for hydropower development: existing sites with hydroelectric facilities that can be rehabilitated, existing sites with hydroelectric facilities that can be upgraded, sites where power generating capability can be added to existing hydraulic facilities, and new sites where full facilities can be constructed. With escalating electrical costs, small hydropower plants offer paper companies a viable means of reducing energy bills and, in many cases, can provide a source of revenue. (Baker-FRC)
W82-05954

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,
Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2, p 377-380, 387, March/April, 1982. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Economic analysis, *Irrigation, *Reservoir storage, Model studies, Crop yield, *Corn, Reservoir design, Soil water, Soil-water-plant relationships, Hydrologic models, Investment.

A method for determining optimum reservoir size, based on economics, was developed for a supplemental irrigation water supply. Crop yields were calculated for irrigated and nonirrigated conditions as well as daily irrigation water requirements using the Duncan-SIMAIZ model. The Haan Water Yield Model was used to calculate daily water yields into a water supply reservoir. The models were used with a reservoir water balance and present worth economics procedure to estimate the economics of investing in supplemental irrigation and to determine the optimum reservoir size. For a sample 100 acre farm planted with 30,000 corn plants per acre in a 300 acre watershed with specified infiltration rate, seepage rate, seepage/runoff ratio, soil moisture capacity, and irrigation management scheme a 40,000 cu m reservoir would produce a return on investment in 50% of the years if $13,000 or less were invested in the irrigation system (pipes, pumps, etc.). In humid areas the major benefits of irrigation would be evident in drought years only. This analysis can also be used to tell an investor the probability of recovering enough return on his investment in a given year to meet the payment on the system at a given interest rate. (Cassar-FRC)
W82-05966

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06059

IMPROVED PRINCIPLES, STANDARDS, AND PROCEDURES FOR EVALUATING FEDERAL WATER PROJECTS,
Wright Water Engineers, Inc., Denver, Co.
L. M. Eisel, G. D. Seinwill, and R. M. Wheeler, Jr.
Water Resources Research, Vol 18, No 2, p 203-210, April, 1982. 43 Ref.

Descriptors: *Water resources development, *Project planning, *Cost analysis, *Nonstructural alternatives, *Water conservation, Planning, Management planning, Economic aspects, Hydroelectric power, Navigation, Recreation, Flood damage, Evaluation.

Many attempts have been made to improve the evaluation criteria for Federal water resources development projects over the past forty years. With the advent of multiobjective planning formulated in the 1973 principles and standards adopted by the U. S. Water Resources Council, the scope of project evaluations has increased. The Council recently revised the 1973 principles and standards for recreation, hydropower, inland navigation, irrigation, flood damage and drainage and developed an auxiliary manual for evaluating the overall attractiveness of alternate plans for water resoruces development. Although these revised procedures for weighing the economic advantages and disadvantages of water resources development are more consistent with theoretical principles, in some cases they require compromises due to limited data, computational complexity, and legal and political constraints. Since the revised principles and standards stress nonstructural alternatives and water conservation, they are expected to be more responsive to the need for cost efficient and environmentally acceptable measures for water resources development. (Geiger-FRC).
W82-06063

RICE FIELDS OF SOUTH CAROLINA: A RESOURCE INVENTORY AND MANAGEMENT POLICY EVALUATION,
Clemson Univ., Columbia, SC. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
C. A. Gresham, and D. D. Hook.
Coastal Zone Management Journal, Vol 9, No 2, p 183-203, 1982. 2 Fig, 9 Tab, 5 Ref.

Descriptors: *Rice, *Water resources development, *South Carolina, Vegetation, Wetlands, Management, Regulations.

This report documents and discusses selected biological attributes and management considerations of the former rice fields of South Carolina. A brief historical background is presented, followed by an inventory made to determine the present biological and management status of the rice fields. State and federal legislation affecting the management of the rice fields is discussed to relate the biological and legal aspects of this resource. Sixteen vegetation cover types were recognized and described. Four types were considered to be managed types; seven types were dominated by marsh grasses and tree species. Of the three drainage system studied, one had a unique cover type composition. It differed from the other two due to flooding associated with the diversion of the Santee River in the 1930s. During the inventory of the drainage systems, 74,113 acres of former rice fields were located. The Waccamaw, Pee Dee, Black system contained 28,076 acres; the Santee system contained 25,456 acres; and the Wando, Cooper and Ashley system contained 20,572 acres. Owners of the former rice fields were managing the rice fields for waterfowl predominately, with snipe, sanctuary, and fish or seafood management clearly secondary. Only 32% of the former rice fields were under management. The owners also indicated that wildlife hunting and fiber production were the preferred future uses of the rice fields. Most of the former rice fields are wetlands under the definition of wetlands in Section 404 of CWA. Thus state and federal permit requirements complicate manipulation and management of former rice fields, which in turn practically prohibits scientific investigation of new compatible uses. (Baker-FRC)
W82-06072

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06170

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,
Illinois State Water Survey, Champaign.
S. A. Changnon, Jr., and R. G. Semonin.
Bulletin of the American Meteorological Society, Vol 63, No 4, p 399-406, April, 1982. 3 Fig, 21 Ref.

Descriptors: *Water resources development, *Weather modification, *Illinois, Artificial precipitation, Cloud seeding, Irrigation, Water supply, Water demand, Farming, Legal aspects, Water rights, Political aspects, Climatic data, Climates, *Climatology, *Weather.

The issues of climate change and prediction, inadvertent weather and climate modification, and planned weather modification are addressed as they relate to a comprehensive statewide water plan being completed in Illinois. The quality and quantity of water resources in that state are seen as irrevocably linked to and dependent upon the climate. Precipitation contributes all available water, even though much of it does not fall in the state but runs through it underground. Conflicts relating to climate result largely from the impacts of short term changes in climate extremes. These conflicts involve both local ones over water use and interagency assistance conflicts to determine who should receive aid. In cases of inadvertent weather modification, the conflict centers around determining who is at fault. The goal of state policy relating to inadvertent modifications is to understand the changes caused by Illinois and their impacts, and to establish policy positions and regulations regarding unfavorable modifications, for the benefit of the area and the nation. Planned weather modification offers a potential means to increase water supplies in Illinois. Farmers and agribusinesses have spent $0.5 million in the past five summers to support cloud seeding projects. Federal agencies have financed $7.8 million for research on weather modification in Illinois. Purposeful rainfall enhancement, if it can be done, has decided cost advantages over irrigation. Conflict in this area may center on moral, religious or environmental grounds. Interstate conflicts are also possible. To serve climate data and information needs a center with a real time access system is recommended. (Baker-FRC)
W82-06176

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,
Metropolitan Washington Council of Government, DC.
A. S. Librach, C. Wiegand, S. Freudberg, M. Sullivan, and R. N. Magill.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineering, Vol 108, No EE3, p 562-577, June, 1982. 9 Fig, 5 Ref.

Descriptors: *Estuaries, *Water resources development, Washington, District of Columbia, *Potomac River, Rivers, Water pollution control, Management, Water quality, Water pollution sources, Nonpoint pollution sources, Water quality management.

This paper presents an overview of the evolution of water quality management philosophy in the Washington, D.C., area, and describes an emerging approach to comprehensive water quality management. To define the problem, the total pollutant loadings to the Potomac Estuary from all sources are described. This is followed by an historical overview of water quality trends in the Estuary and the management response to perceived water quality problems. The estimated costs of providing increasingly higher levels of sewage treatment are then presented. Finally, the paper describes an evolving approach based on an analysis of tradeoffs between the various pollution control options available to determine the most cost effective and practical ways of achieving specific and realistic water quality goals. The new management approach evolving may replace the region's traditional and almost exclusive reliance on control of point source loadings to meet rigidly defined and interpreted water use definitions and quality standards. This new approach is more flexible and practical in the consideration of the impacts, controllability, and costs to control all loading sources. The approach would employ return frequency and economic considerations in tandem with sophisticated water quality model simulations to help identify the most cost-effective management solutions. To support a long term management strategy, a state of the art eutrophication model for the Potomac Estuary is being developed. (Baker-FRC)
W82-06361

WATER SUPPLY DEVELOPMENT IN THAILAND.
Water Services, Vol 84, No 1008, p S14-S16, S19, S20, February, 1980. 4 Fig, 2 Tab.

Descriptors: *Water supply development, *Planning, *Thailand, Water resources development, Water conveyance, Water supply.

It is estimated that the population of Thailand in 1977 was about 44,000,000, corresponding to an

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average density of 85 persons per square kilometer. The Metropolitan Water Works Authority was founded in 1967 when the Thai Government combined the four municipal water authorities of Bangkok, Thonburi, Nonthaburi, and Samut Prakarn under the Ministry of Interior. The source of Bangkok's surface water is the Chao Phya River at Sam Lae, about 35 meters north of Bangkok. The water is relatively unpolluted and is above the reach of sea tides. Capital improvement programs and future work plans for the increasing population are reviewed. Water systems, construction programs, budgets and typical costs for water service in the rural areas are also noted. (Baker-FRC)
W82-06367

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.
Delaware Univ., Newark. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256611, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1982. 52 p, 10 Fig, 20 Ref. OWRT C-90191-G(9443)(1).

Descriptors: *Streams, *Environmental protection, *Public participation, *Public policy, *Public waters, Environmental impact statement, Environmental quality, Water quality control, Water quality, Valley springs, Valleys, Urban planning, Public opinion, Attitudes, Public lands, Land development, Storm runoff, Management planning.

The use of citizen panels was explored for interpreting technical information and for serving as intermediates between the unaffiliated public and institutions/governments, which hold the technical information. A Nominal Group Transaction mode is used to generate recommendations, and short-subject videotape movies are used as a communication device in a process for enhancing public participation in protecting/improving a stream valley environment. The results of this study are presented as a prototype for general application. The White Clay Creek Valley functioned as a study case area, with several recommendations being developed for application to stream valleys. These are that: the stream proposals evaluated for potential adverse environmental impacts; the stream valley core should be reserved for low-intensity uses (recreation, nature preserves, woodlands); a planning program for conservation/management practices should be established to treat streams of different order; and that a citizen's council should be established to monitor/inform/serve the public interest in the watershed on important issues (e.g., future development, stormwater management, maintaining biological diversity, recreation). (Zielinski-MAXIMA)
W82-06368

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,
Texas Water Resources Inst. College Station.
For primary bibliographic entry see Field 3F.
W82-06374

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,
North Yorkshire County Council (England).
P. Lawson.
Hydrobiologia, Vol 88, No 1-2, p 19-26, March, 1982. 6 Ref.

Descriptors: *Economic aspects, Evaluation, *Prediction, *Reservoirs, *Water demand, Cost analysis, Water rates, Economic evaluation, Economic prediction, Public policy, Projections, Forecasting, Growth rates, Economic justification, Water supply, Rutland Water, England.

Arguments for and against reservoir development in Rutland, United Kingdom, are presented. The process of decision-making which took place in the mid-1960s highlighted basic conflicts between urban expansion and rural agriculture. Debate at the local level and in Parliament raised issues which are still unresolved. Because the Rutland Water scheme involved changing the course of a river, the consent of Parliament was required. Local objections concerned land use disruption, effects on the local economy, landscape impact, and drawdown effects. Arguments for the project were that per capita consumption of water was expected to increase, existing water sources were overextended, and no alterntives were available as short-term solutions. (Titus-FRC)
W82-06480

INTRODUCTION - RUTLAND WATER 1970-1981,
Leicester Univ. (England), Dept. of Adult Education.
D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 1-5, March, 1982. 4 Fig, 9 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, Evaluation, *Project planning, Water supply, Water demand, Public opinion, Public policy, Water policy, Construction, *Rutland Water, England.

Rutland Water (Empingham Reservoir) was officially established in May 1970 by the Mid-Northamptonshire Water Act. Within 10 years, the completed reservoir had reached its top water level and the dam had been inspected; about half its design capacity was being used for water supply and it had received national acclaim for its wildfowl populations. The Rutland Water Research Group sponsored a conference to review the changes associated with the reservoir in its first decade. The controversy which arose during the planning of this pumped-storage reservoir, primarily due to its size and location, still exists despite the success of its recreational provisions and water supply management. (Titus-FRC)
W82-06482

FACT FINDING HEARING - COTTONWOOD CREEK INSTREAM BENEFICIAL USE PROGRAM,
California Regional Water Quality Control Board, Sacramento.
Staff report, June 1982. 150 p, 5 Fig, 10 Tab, 42 Ref, 5 Append.

Descriptors: *Streams, *Rivers, *Beneficial use, *Water quality management, *Water permits, *Public hearings, Water policy, Water rights, Water supply, Water temperature, Fisheries, Recreation demand, Wildlife management.

The California State Water Resources Control Board's responsibilities include issuing water rights applications and permits in an effort to protect the public interest and to mitigate adverse environmental impacts. Both quality and quantity determine the amount of water to be left in a source to protect instream beneficial uses. The primary instream beneficial uses of the Cottonwood Creek System, which includes part of the Sacramento River, are recreation (boating/fishing) and fisheries. This report presents three options comprising seven alternatives for the system's instream use management. The alternatives are: 1) to maintain the existing levels of instream beneficial uses in both systems, but with temperature and turbidity/siltation controls; 2) to maintain reduced levels of instream uses in both systems, i.e., 50% of the total present salmon fishery, 97% of the present recreation at Cottonwood and 75% at Sacramento; 3) to maintain 50% of the present salmon fishery at Cottonwood and existing levels of instream use at Sacramento; 4) to maintain current levels of instream uses at Cottonwood and decrease levels at Sacramento; 5) to maintain instream uses at Cottonwood and increase fishery and recreation levels at Sacramento; 6) to increase Cottonwood's instream uses and maintain existing instream uses at Sacramento. Alternative 7, the recommended program, includes water temperature control, stream channel/streambank protection, best management practices to control nonpoint sources of pollution, and gravel cleaning and replenishment. The above objectives would be implemented by federal, state and local agencies. (Atkins-Omniplan)
W82-06522

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2E.
W82-06523

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,
Nevada Univ. System, Reno. Desert Research Inst.
R. C. Broadbent, S. C. Weaver, J. W. Fordham, and G. F. Cochran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256702, Price codes: A06 in paper copy, A01 in microfiche. Publication No. 41074, January 1982. 132 p, 61 Fig, 14 Tab, 39 Ref. OWRT B-104-NEV(1), 14-34-0001-8099.

Descriptors: *Artificial recharge, *Aquifer management, *Water resources development, *Surface-groundwater relationships, *Mathematical models, Aquifer systems, Aquifer testing, Rivers, Planning, Forecasting, Water loss, Water costs, Economic aspects, Computer models, Mathematical studies, Model studies, Groundwater availability, *Colorado River, *Nevada.

Study was undertaken to assess whether and how southern Nevada can take maximum advantage of excess Colorado Rriver (CR) diversion capacity that is expected to exist over the next 20 years through the southern Nevada water supply system. Analysis of the water resource system defined a range of potential groundwater(GW)-surface water management scenarios defined by the resource system model. Chemical equilibria calculations and sediment-water mixing experiments were also conducted. The study results led to conclusions that: the apparent least-cost management strategy is to continue GW pumping at the current rate without salvaging lost CR water, but failure to build a water reserve for future use and the problems inducible by such failure may make this strategy undesirable; artificial recharge of CR water is technically feasible but probably undesirable economically; reduction in current total GW pumpage to 40,000-45,000 acre/foot/year would permit salvage of CR water by maximizing its use and allowing GW reservoir replenishment, however reduced GW pumpage would induce higher water costs. (Zielinski-MAXIMA)
W82-06694

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,
Missouri Water Resources Research Center, Columbia.
J. M. Sharp, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256728, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 27 p, 4 Fig, 4 Tab, 26 Ref. OWRT A-129-MO(2), 14-34-0001-0127.

Descriptors: *Alluvial aquifers, *Alluvium, *Computer models, *Hydraulic properties, *Water exchange, Water resources development, Computer programs, Model studies, Mathematical studies, Mathematical models, Surface water, Flow discharge, Water storage, Induced infiltration, Recharge basins, Instream flow, Consumptive use, *Missouri River.

Research was conducted: to estimate the water resources potential of the lower Missouri River Valley alluvial aquifer (AA) from Rulo, Nebraska to St. Charles, Missouri; to provide mechanisms for improving hydraulic property estimates of the AA; and to ascertain the problem or future problem potential regarding the AA and associated surface waters. Drill hole and pump test data for the AA were re-evaluated. Flow rates of the Mis-

souri River and its major tributaries in the study area were tabulated. A flow-storage-recharge-pumping model (consisting of about 50 submodels, each covering about 10 miles of the 498 mile AA length) was developed for conjunctive use of the stream/aquifer system. Qualitative assessment was made of instream flow problems of the lower Missouri River system. It was concluded that: better data are needed on groundwater/river interactions and stream channel changes; that water use data are highly variable, making accurate projections of Missouri water demands presently impossible; that, due to local demands and projected upstream dimensions and consumptive use, water resources of the lower River AA system are deemed as potentially critical. New determinations of stream-flow needs for lower River fish/wildlife will offer a constraint on available groundwater in the Alluvium. Detailed analyses of river-aquifer water exchange indicate local inhomogeneities control the near river response patterns. (Zielinski-MAXIMA)
W82-06696

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
H. J. Vaux. Jr., and M. Neiman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256744, Price codes: A03 in paper copy, A01 in microfiche. Water Report, September, Davis, Calif. 1980, 22 p, 2 Tab.

Descriptors: *Institutional constraints, *Groundwater management, *California, *Economic aspects, *Model studies, Water management, Groundwater basins, Institutions, Water law, Legal aspects, Feasibility studies, Public participation, Hydrologic systems, Mathematical models, Cost-benefit analysis, Future planning, Estimated benefits, Surface water availability.

The effectiveness of existing groundwater management institutions, using economic models and institutioal analysis to identify alternative institutional arrangements and their feasibility, was examined. Using existing groundwater basins, a sensitivity analysis assessed the change in economic incentive with a change in various parameters (e.g., discount rate; surface water availability). It was concluded that California water institutions/laws developed in a period having characteristics differing sharply from California's current groundwater situation. Further, Californians have preferred supply-augmenting solutions involving broad public participation, often being economically inefficient. New water management institutions cannot be expected to operate effectively unless they are designed to at least partially accomodate prevailing public attitudes/preferences, existing hydrologic and engineering of current water supply systems, and the perception that economic efficiency is not always paramount. Analysis of the southern San Joaquin indicated that in the absence of supplemental supplies, groundwater management may still be justified in economic grounds, provided such management costs are modest. A revised institutional structure will be needed to meet future groundwater demands. A dynamic optimization model is described which was used to establish the existence of net benefits from groundwater management, (Zielinski-MAXIMA)
W82-06700

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,
George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
D. P. Beard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256785, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center, Washington, DC., Report No 36, February 1982. 183 p, 26 Fig, 67 Ref, 8 append. OWRT A-016-DC(1).

Descriptors: *Water supply, *District of Columbia, *Management planning, *Institutional constraints, *Regional planning, Water costs, User charges, Water shortage, Available water, Urban planning, Planning, Future planning, Drought, Water deficit, Economic aspects, River basins, Evaluation, Water resources development, Water requirements.

The water supply management structure and its operation are described for the District of Columbia, as well as the issue it will face in the 1980's and how the District is prepared to deal with these issues. These issues include: adequacy of future water supplies; regional cooperation; water supply emergency and drought management; water supply system rehabilitation; water billing/collection; and rate increases and conservation pricing. Major emphasis is given to detailed definition of the Potomac River basin, the legal and institutional management of the River, the overall water supply network in the Washington metropolitan region, and the water supply management functions in the District. The District water supply was found to be reliable, inexpensive and of good quality. Other than some administrative concerns (e.g., billing/collection), the District water management system performs adequately. Recent studies do not forecast water supply shortages, and regional cooperation appears to be improving. However, while the water supply future in the District area appears optimistic, caution is urged to ensure continued and improved cooperation as a critical factor in meeting future water supply needs. (Zielinski-MAXIMA)
W82-06704

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
A. O. Esogbue, and Z. M. Ahipo.
Water Resources Bulletin, Vol 18, No 3, p 451-456, June, 1982. 4 Fig, 11 Ref. OWRT B-147-GA.

Descriptors: *Water resources development, *Planning, *Public participation, Public relations, Nonpoint pollution sources, Pollution load, Attitudes, Social participation, Future planning, *Fuzzy sets, *Model studies, Mathematical studies, Algorithms.

An effort to apply the technique of fuzzy set modeling to an important problem in an areawide based approach to managing a scarce and diminishing natural resources is reported. Research in nonpoint water pollution control planning via fuzzy sets is aimed at planning under uncertainty and in a fuzzy environment, especially with respect to fuzzy goals/objectives and enforcement problems; to the scientific determination of best management practices (BMP's); to measure the effectiveness of BMP's as control procedures for nonpoint source pollution; and to measure and improve the effectiveness of public participation in water resources planning from a quality viewpoint. Specifically, a fuzzy set model is developed for quantifying and measuring the effectiveness of public participation. The model is essentially cascade in nature and employes the concepts of fuzzy pessimistic and optimistic aggregation to cluster and analyze the evaluations of the basic factors. Sample computations of the model are provided. (Baker-FRC)
W82-06778

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
M. V. Martin, and L. M. Arthur.
Water Resources Bulletin, Vol 18, No 3, p 481-484, June, 1982. 1 Fig, 13 Ref.

Descriptors: *Inland waterways, *Navigation, Planning, Canals, Navigable rivers, Waterways, Feasibility studies, Financial feasibility, Cost-benefit analysis, Bonneville Lock, Columbia River, *Oregon.

One cause of delays in projects to develop inland waterway transportation is a lack of analytical credibility associated with the project. This was examined in connection with the proposal to construct a new, expanded lock at the Bonneville Dam on the Columbia River. At present commercial waterborne transport extends 465 miles upriver and accommodates barges of up to 3,200 tons capacity. Between 1938 and 1975 eight locks were built on the Snake-Columbia system, primarily as co-serve facilities with hydroelectric dams, but the lock system has also contributed to irrigation of cropland. Therefore, any proposed changes must consider all these aspects as well. In evaluating the benefits and costs of a proposed waterway project, two scenarios must be compared: projected economic development with the project vs. development expected to occur without the project. By following a carefully defined set of analytical guidelines, specific enough to ensure consistency and completeness, yet flexible in application, it is hoped that some of the delays currently caused by a lack of definitive project analyses will be diminished. (Baker-FRC)
W82-06869

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COUNT ON UNCLE SAM LESS,
Office of the Secretary of the Army, Washington, DC.
W. R. Gianelli.
Civil Engineering (New York), Vol 52, No 4, p 49-52, April, 1982. 3 Fig.

Descriptors: Water resources development, *Planning, Design criteria, Financial aspects, *Government finance, *Government supports, Economic aspects, Federal jurisdiction, *Political aspects.

Under the present federal budget crunch, old ways of managing water resources projects will no longer work. New directions are needed which will call for increased participation of other sectors in planning, cost-sharing, and financing proposed federal water projects. Estimates suggest that as much as $20 billion could be invested in the coming decade for potential water projects, including areas such as navigation, flood damage reduction, hydropower, and municipal and industrial water supplies. The number of new federal project construction starts has decreased steadily over the past few years. The Administration plans to identify what the federal role in various water projects should be. One key feature is the establishing of national economic development output of proposed projects. Water projects with only local or regional beneficiaries may not qualify as they have in the past for federal financing. However, federal expertise in the planning and construction of water projects may continue to be available. One way to assure that the planning process concentrates on those projects with the highest likelihood of being implemented is for project sponsors to participate in study financing. It is proposed that the new Corps of Engineers studies be done in two stages. The federally financed reconnaissance stage would require 12-18 months, with the subsequent feasibility stage being cost-shared 50/50 with the federal government and another project sponsor. (Baker-FRC)
W82-05998

COST OF WASH HOUSES AND COMFORT STATIONS AT RECREATION AREAS,
Army Engineers Waterways Experiment Station, Vicksburg, MS.
A. K. Lindsey, and T. M. Walski.
Water Resources Bulletin, Vol 18, No 2, p 331-334, April, 1982. 3 Fig, 4 Ref.

Descriptors: *Recreation wastes, *Sanitary engineering, *Costs, Estimated costs.

Cost functions are presented for comparison of different types of sanitary facilities (vault toilets, wash houses, and comfort stations) built at water resources projects. Functions for exterior costs are computed for plywood siding with asphalt or cedar shingles, concrete masonry units with asphalt or cedar shingles, concrete masonry units

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with brick veneer and asphalt shingles, concrete units with brick veneer and cedar shingles, and cedar siding with cedar shingles. Interior cost functions are given according to type and number of toilets and fixtures. An equation for total construction costs includes exterior and interior costs, the elaborateness of design, and an allowance for inflation. Area of the building may be determined by an equation which includes number and type of fixtures and a spaciousness factor. An example is given in which the type and cost estimates for a wash house are prepared. (Cassar-FRC)
W82-06042

HOW EQUITABLE ARE EFFLUENT CHARGES,
Furness (C. D.) and Associates Ltd. (England).
C. D. Furness.
Effluent and Water Treatment Journal, Vol 22, No 3, p 99-100, 102-103, March, 1982. 5 Tab, 8 Ref.

Descriptors: *Effluent charges, *Effluent limitations, *Industrial wastes, *Mathematical studies, Accounting, Pollution taxes, Water quality standards, Effluents, Cost allocation, Cost sharing, Water quality management.

Evidence is given to substantiate the contention that the apportioning of the costing elements in the Mogden-type charging formula for effluent discharges which has been used in Great Britain since 1974 is imprecise and therefore unequitable. Figures are given to illustrate that there are significant variations in the total charges imposed on industrial dischargers by the Regional Water Authorities for the reception and treatment of their regional average strength effluents. Thus these charges do not provide a true basis for comparison. Comparisons have been attempted by calculating the charges levied by each authority for the reception and treatment of a fixed weight of pollutant when contained in the relevant volume of regional average-strength effluent for a particular region. Another method of comparing the charges levied by each authority is unit costing of a given weight of water or pollutant received for treatment. Charges for COD, BOD, and the solids strength of the effluent are still used by many water authorities. It was concluded that an increased degree of uniformity with respect to the assessment of polluting strengths and the apportionment of the charging elements would remove any anomalies in the charges imposed and ensure more equitable charging in the future. (Geiger-FRC)
W82-06074

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,
Illinois Dept. of Energy and Natural Resources, Chicago.
For primary bibliographic entry see Field 5F.
W82-06098

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12
Huff and Huff, Inc, Chicago, IL.
For primary bibliographic entry see Field 5G.
W82-06099

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,
Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
For primary bibliographic entry see Field 5G.
W82-06207

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,
Stanley Consultants, Inc., Muscatine, IA.
R. H. Stanley, and R. L. Luiken.
Public Works, Vol 113, No 5, p 70-73, 116, May, 1982. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Water rates, *Water costs, *Peak demand, Water metering, Utilities, Prices.

Utility rate structures should encourage conservation, efficiency, and equitable rates. The rate system should also produce a stable revenue for the company. The rate making process consists of several major steps: determine revenue requirements for the selected year, allocate the cost of service to each rate class, and design rates consistent with the results of costs of service analyses. The cost of service methodology involves three major steps: arrange investments and operating costs into major divisions such as supply, treatment, fire protection, etc.; determine appropriate customer, demand, and commodity allocation factors for each rate class; and allocate costs to each rate class. This procedure is illustrated in detail. Allocation of demand-related costs to the different rate classes is important and difficult. The American Water Works Association Base-Extra Capacity methodology is recommended for this. The rate structure for each class should produce revenues matching the overall cost of service for that class. In general, seasonal and ratchet rates result in more equitable charges than the traditional annual rate approach. They are also effective in reducing peak day and peak hour demands. However, the seasonal and ratchet rates result in less revenue stability because they are more dependent on weather and customer summer usage habits. It is predicted that in the future there will be greater use of seasonal rates, fewer declining blocks and less price differential between blocks, and recovery of customer-related costs by separate customer or service charges. (Cassar-FRC)
W82-06222

STATISTICAL COST FUNCTION FOR WATER MAINS,
Canadian Department of Supply and Services, Ottawa, Ontario. Bureau of Management Consulting.
B. M. Firestone.
Water/Engineering and Management, Vol 129, No 5, p 50-52, May, 1982. 4 Ref.

Descriptors: *Cost analysis, *Water mains, Mathematical equations, Planning, Statistical analysis, Mathematical studies, Installation, Water conveyance, Pipelines.

A statistical function relating costs and flow volumes is needed for a determination of optimal pipe diameters when planning for water main installation., Such a function will help avoid the installation of excessive capacity and unnecessarily high costs. Premature duplication of water mains and unnecessary disruption will also be avoided. The ratio of pipe cost per unit length to flow will decrease as capacity or flow increases. The existence of a 'two-thirds rule' has been suggested - costs rise as the two-thirds power of output capacity. this rule is used by engineers in estimating the cost of new process equipment. In this paper the hypothesis suggests that total in situ pipe costs per unit length (TC) can be expressed as a function of flow capacity (Q) and length of section laid (L). An equation is suggested, and data derived from melbourne and the Metropolitan Board of Works records is used to demonstrate its effectiveness. The findings suggest that set-up costs act as a fixed cost, invariant with pipe diameter or the length of section laid. A decrease in predicted replacement costs per mile noted, which also results from short sections commonly being laid in developed areas where main laying costs are very high. Thus longer sections will show a lower cost per mile. To estimate increasing returns to scale with flow, the confounding influence of length of section laid must be removed. The conclusion is drawn that efforts should be directed toward laying the longest possible continuous section lengths at any one time. Planners should also consider the substantial scale economies existing with respect to flow when determining optimal pipe sizes. (Baker-FRC)
W82-06252

WATER UTILITY COSTS AND RATE DESIGN FOR FIRE PROTECTION SERVICES,
CH2M/Hill, Portland, OR.
C. W. Corssmit, and D. D. Green.
Journal of the American Water Works Association, Vol 74, No 6, p 270-277, June, 1982. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Pricing, *Water users, Economic aspects, Alaska, Fire protection, Water rates, Water demand.

A 1981 cost-of-service analysis was made of water and fire flow demands. Rates for water provided by Central Alaska Utilities for fire protection were based on data from that study. Fire protection costs were then allocated to all water system users, who are charged for each block of fire flow demand required to protect their properties. In order to design such a system the database used must be significantly comprehensive to enable the identification of annual revenue requirements by appropriate cost functions. The capacity cost method provides some important advantages over the incremental cost method. All functions of the system are treated on an equal basis for cost allocations, and there is no need to declare primary versus secondary purposes. Incremental cost calculations, which can be cumbersome when multiple cost functions are involved for a number of utility components, are not needed. Finally, the capacity cost method conforms with the base extra capacity cost allocation method that is used to delineate both the capital and the operation and maintenance costs and therefore all demand data can be used on a coincidental demand basis. The advantages and disadvantages of several alternatives are described. (Baker-FRC)
W82-06275

WATER RATES AND RESIDENTIAL WATER CONSERVATION,
National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 3D.
W82-06276

COST-BASED WATER RATE DESIGN,
Norville (Rodney L.) and Co., Houston, TX.
R. B. Matthews, and S. Webster.
Journal of the American Water Works Association, Vol 74, No 6, p 282-284, June, 1982. 3 Tab.

Descriptors: *Water use, *Pricing, Conservation, *Water rates, Economic aspects, Water conservation, *Cost-based water rates.

In order to finance major capital expenditures needed for improvements to water systems, some manner of making the necessary rate increases more palatable to the public must be found. Often the solution may be the use of a cost based rate design as an alternative to the traditional declining block rate structure. A system of rate structures that more clearly links the cost of meeting demands with the customers who impose the peak requirements appears to be a positive approach. Such a rate structure requires a definition of peaking characteristics and of groups of customers with similar peaking characteristics. Among residential customers in both single-family and multifamily dwellings, peaking intensifies as consumption increases. Once water use reaches a sufficient level to meet basic consumption and housekeeping needs, additional consumption results from discretionary intermittent water consumption. Among industrial and commercial customers, peaking decreases as consumption increases. If cost based rates are the objective of rate structures, the first step in implementation is to acquire data to define the relevant classes of customers. Cost based rate design is not a conservation rate in the sense of implying conscious bias in rate design against large volume users. It is based only on an objective cost of service analysis. The only change from traditional practices is a redefined customer classification scheme. A cost based rate structure effectively correlates cost with the individual customer who has the ability to pay. The retention of declining rate blocks for commercial and industrial customers eliminates the lack of incentive for industrial and commercial development inherent in many rate structures that seek to motivate water conservation. (Baker-FRC)
W82-06277

STATISTICAL SAMPLING TECHNIQUE FOR CONTROLLING THE ACCURACY OF SMALL WATER METERS,
Hackensack Water Co., Harrington Park, NJ.
P. Tao.
Journal of the American Water Works Association, Vol 74, No 6, p 296-304, June, 1982. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Water metering, *Measuring instruments, *Statistical methods, Maintenance.

Through the use of a statistical sampling program based on random sampling theory, drawbacks associated with the periodic age change program for water meters can be corrected. The two drawbacks associated with the periodic age change program for meters are that more than 90% of the meters repaired under the periodic age change program are still serviceable, and therefore the cost of unnecessary meter repair imposes a burden on the water utility and its customers, and second, once the meters are set on the customers' premises, no regular program is undertaken to check the accuracy of the meters until the next age repair. The statistical sampling scheme, as a substitute for the periodic meter age change program, will solve these problems. Such a program proposed for Hackensak, New Jersey, will reduce the number of meter changes and repairs by 6000 per year at a saving of $94,000, based on 1977 costs. A further effect of the proposed program will be to reduce unaccounted for water by a small percentage., The core of the program is the design phase and making the decision as to whether to accept the premise that 70% of the meters or more are accurate and 10% or less of the meters are fast. This meter sampling program went into effect in 1980. The program will be re-evaluated in 1983, but at the moment the results appear promising, and it is felt that statistical sampling will successfully replace the 15-year meter change program. (Baker-FRC)
W82-06350

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,
Florida Univ., Gainesville. Dept. of Food and Resources Economics.
D. Comer, and R. Beilock.
Journal of the American Water Works Association, Vol 74, No 6, p 285-287, June, 1982. 2 Tab, 3 Ref.

Descriptors: *Water conservation, *Pricing, Water users, Water rates, Economic aspects, Conservation.

Decision makers must analyze the implications of alternative rate structure devices carefully, with respect both to the projected results from implementing a new rate structure and to the sensitivity of those results to the underlying assumptions that are made to generate the projections. Decision makers need to examine the implications of alternative pricing structures by varying the underlying assumptions so that a range of projections from which to choose a new rate structure is available. The sensitivity of the results of a declining rate structure to changes in the accompanying underlying assumptions is examined. The example considered was used to demonstrate how a declining rate structure can be more effective in conserving water than either an inclining or a single rate structure. Three assumptions are crucial to the results of this method. First, the revenues collected cannot be greater than the revenues needed. The second asssumption concerns the relative sizes of the high- and low-use groups. For water conservation purposes, a declining rate structure becomes less effective as the high use groups become larger in relation to the low use groups. When a pricing system is designed to promote consumption by one group relative to another, the larger the group enjoying lower prices, the greater will be total consumption. The third assumption concerns the relative price elasticities between the groups. The absolute value of the elasticity indicates the responsiveness of quantity demanded to a change in price, and the sign of the elasticity indicates the type of response that occurs. (Baker-FRC)
W82-06351

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06382

CRISIS: FINANCING WATER AND WASTEWATER,
Thames Water Authority, London (England).
E. J. Gilliland, and S. H. Hanke.
Water/Engineering and Management, Vol 129, No 7, p 41-43, June, 1982. 4 Ref.

Descriptors: *Financing, *Accounting, *Depreciation, *Water treatment, *Wastewater treatment, Economic aspects, Capital, Water rates, Pricing, Grants, Loans, User charges.

Developments in financing water and wastewater treatment are discussed. Four methods of financing capital investments are available: contributions by new customers (connection charges, etc.), government grants, loans, and self-financing. The preponderance of external financig over self-financing has produced several effects on the utilities' financial policies: inadequate charges, dependence on bond issues, favoring low capital cost outlays which may entail higher long-term operating costs, inhibitation of capital investments, and inadequate cash for replacement. To remedy these problems depreciation charges on the current written-down value of assets should be included. The problems of inflation, replacement or rehabilitation of aging assets, and shortage of capital has led to some recommendations by groups in Australia and the United Kingdom. Basically, they call for depreciation on the current cost basis, increased self-financing, more realistic charges for use, integration of financial planning in the management process, and a uniform cost accounting practice. (Cassar-FRC)
W82-06641

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,
Denver Research Inst., CO.
For primary bibliographic entry see Field 3C.
W82-06693

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06796

METHODS FOR APPORTIONING THE COST OF A WATER RESOURCE PROJECT,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. P. Heaney, and R. E. Dickinson.
Water Resources Research, Vol 18, No 3, p 476-482, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: Water resources projects, *Cost allocation, *Pricing, Economic aspects, Cost analysis, Costs, Model studies, Mathematical studies, Mathematical equations, Game theory, Tennessee Valley Authority.

Existing methods for examining the problem of apportioning costs among project participants in a fair manner are reviewed. Concepts from cooperative n-person game theory are offered as providing a unified conceptual framework for doing these analyses. Finally, a new method, the minimum costs, remaining savings (MCRS) method is proposed as an improvement over existing techniques. The MCRS method can be viewed as a generalization of the presently used separable costs, remaining benefits method. (Baker-FRC)
W82-06853

COST ALLOCATION IN WATER RESOURCES DEVELOPMENT,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
H. P. Young, N. Okada, and T. Hashimoto.
Water Resources Research, Vol 18, No 3, p 463-475, June, 1982. 3 Fig, 10 Tab, 31 Ref.

Descriptors: *Water resources development, *Cost allocation, Pricing, Economic aspects, Cost analysis, Costs, Mathematical studies, Mathematical equations, Multipurpose reservoirs, Game theory, Sweden.

It is necessary to choose rationally among the many different methods of allocating the costs of a joint water resource facility among the different area users. Using a definite computational procedure itself provides some semblance of rationality. However, the justification of a method lies in its behavior in practice, and it is thus necessary to compare the different methods on the basis of principle. Among the most important of these principles are individual rationality, group rationality, insensitivity to the definition of direct costs, monotonicity in costs, and no payments to dummies. A more general principle is simplicity in terms of computational and informational demands. Game theory methods all suffer from the disadvantage that they are fairly complicated and require detailed information on costs. All the methods except for the simplest proportional allocation schemes rely on information about demands and the optimal scale of development that in practice may be unreliable or nonexistent. This is particularly true for long term investment projects. It is therefore not surprising to find that a simple scheme based on allocating costs in proportion to the population was the one actually chosen. (Baker-FRC)
W82-06854

6D. Water Demand

THE ENERGY RESOURCES OF KENYA,
Ewbank and Partners Ltd., Brighton (England).
P. W. Fielder, and T. W. Berrie.
International Water Power and Dam Construction, Vol 4, No 4, p 39-41, April, 1982. 4 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Economic aspects, Hydroelectric plants, Powerplants, Electric power, *Kenya, South Africa, Developing countries, Regional development, Energy.

In attempting to meet the high cost of imported fossil fuels, Kenya is trying to develop its local energy sources such as hydropower, as well as strengthen the interconnecting links with surrounding countries. Commercial energy consumption in Kenya is below that for the average low-income countries, but its energy imports as a percentage of merchandise exports are high, due to the very high cost of oil imports. The main indigenous energy resource is hydroelectric power with a potential of about 5500 MW. About half of this is scattered among small rivers, many of which are economically exploitable. The main source of hydroelectric power is the Tana River. The main thermal station, Kipevu, is on the coast of Mombasa. There are diesel plants at Nairobi and other load centers with gas turbines for peaking at both Mombassa and Nairobi. The most important factor for ensuring optimum generation is making the best use of the Tana River flow which is a function of rainfall patterns. (Baker-FRC)
W82-05978

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.

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For primary bibliographic entry see Field 3B.
W82-06136

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
J. A. Ziegler, and S. E. Bell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243759, Price codes: A05 in paper copy, A01 in microfiche. Publication No 85, September 1981. 86 p, 17 Tab, 81 Ref. OWRT A-048-ARK(1), 14-34-0001-9999.

Descriptors: *Cost analysis, *Water demand, *Industrial water, *Estimated costs, Mathematical studies, Cooling water, Economic aspects, Costs, Projections, Prediction, Water costs, Planning, Water use, User charges, Water use efficiency, *Chemical industry, *Pulp and paper industry, Evaluation, Estimating equations, *Arkansas.

Water demand functions were estimated for the paper and chemical industries in Arkansas using data collected from individual industrial plants throughout the state. Water demand functions were estimated using regression analysis on data derived from information on: water intake and gross use by source; recirculated water use; costs of acquiring, treating, and discharging water; plant output; plant employment; and plant level of technology. The demand for water intake was primarily estimated as an exponential function of the average water costs and the level of technology. Cost elasticities of demand were estimated as being approximately equal to one for both industry types (-0.94 for chemical plants; -1.06 for paper plants). It was determined that the results could be used to assess the effects of various public policies (e.g., water quality standards) on water withdrawal for industrial purposes. From historical analysis and water demand function estimates, it appeared that industrial water use has followed national trends, particulqrly for the heaviest industrial water user, the paper industry. However, the data indicated that the two Arkansas industries examined are somewhat more responsive to water cost changes than is true nationally. (Zielinski-MAXIMA)
W82-06160

AN INVESTIGATION OF SOME FACTORS INFLUENCING THE PERFORMANCE OF A RECREATIONAL TROUT FISHERY,
Severn-Trent Water Authority, Birmingham (England), Scientific Services.
K. A. Bryan.
Journal of Applied Ecology, Vol 19, No 1, p 113-131, April, 1982. * Fig, 5 Tab, 29 Ref.

Descriptors: *Fish populations, *Recreation facilities, Fishing, Water quality, Tittesworth Reservoirs, Lakes, Drawdown, Drought, Water demand.

Following complaints from fishermen that the fish in the Titteworth Reservoir 'put and take' trout fishery were emaciated and difficult to catch, an investigation was conducted comparing these fish with fish from other sources, as well as monitoring water quality and phytoplankton samples. The trout were shown to have suffered a temporary setback in 1976, which was primarily atrributable to the drought of 1975/76. Phytoplankton numbers, which prior to 1976 were considered large enough to warrant annual treatment with copper slufate, dropped significantly and had not recovered by 1979. Chemical analyses had not revealed any change in water quality. Nitrate and silicate concentrations showed no trends during 1969-79, although phosphate levels decreased very slightly. The severe drawdown and reduced retention time of the reservoir in 1975-76 was perhaps the reason for the diminished phytoplankton, although it is more commonly thought that the greatly increased zooplankton population contributed to the algal loss through grazing. Analysis of the gut contents of trout in 1977 and 1978 revealed that large amounts of plant material and indigestible items had been eaten. Fish stomachs in both years were frequently empty. It was concluded that the repeated drawdown of the reservoir for water supply, including the effects of the 1975-76 drought, may have reduced the numbers and species diversity of food organisms available. (Baker-FRC)
W82-06329

POLICING DEMAND THROUGH PRICING,
Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, Jr.
Journal of the American Water Works Association, Vol 74, No 6, p 288-291, June, 1982.

Descriptors: *Water demand, *Pricing, Conservation, Economic aspects, Water conservation, Water rates, Fairfax County Water Authority, *Virginia.

The Fairfax County Water Authority provides water service to a large segment of the northern Virginia population, comprising all or part of three municipal jurisdictions. The authority acts as the county's billing agent for sewer service charges based on water consumption. The area has an annual average rainfall of 12 meters. The case for water use management or conservation stems not from a scarcity of water but rather from the unwillingness of the citizenry to construct unwarranted water and sewer facilities. The water use management goal for this area is aimed at utilizing the water economically and assessing the cost for various activities equitably. The objective is to avoid wasting water regardless of the water use activity the customer selects, without passing judgment on the merits of the activity. The four most sifnificant activities for fostering a more acceptable customer attitude for direct water conservation include alerting customers to unusually high consumption prior to billing and investigating the cause, issuing pressure-reducing valves without cost to customers whose plumbing predates the existing Code, submitting suggestions for plumbing code revisions relative to water conservation to the jurisdictions served by the authority, and utilizing a peak use charge as part of a rate schedule to lower the maximum or peak demands The peak use charge applied in this county is acceptable to customers because it economically encourages water conservation during peak seasons, it is a fair and equitable rate, it is not punitive, it has an economic basis, it affects only the one fourth of the customers who create the demand, and customers who minimize winter consumption and who do not exceed their peak period allowance can maintain an economical annual water and sewer cost. (Baker-FRC)
W82-06352

DISTRIBUTING THE RISKS OF INTERBASIN WATER TRANSFERS UNDER DROUGHT CONDITIONS: THE DILEMMA POSED BY COAL SLURRY PIPELINES.
Teknekron, Inc., Berkeley, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256595, Price codes: A10 in paper copy, A01 in microfiche. Report, March, 1982. 201 p, 13 Fig, 41 Tab, 98 Ref, 4 Append. OWRT C-90202-G (0419) (1) 14-34-0001-0419.

Descriptors: *Interbasin transfers, *Pipelines, *Coal, *Drought, *Water supply, Water transfer, Conveyance structures, Pipes, Slurries, Coal mining, Water deficit, Water shortage, Water demand, Water conveyance, Water requirements, Interstate compacts, Water use, Alternative water use.

Problems are examined concerning the use of western water to transport coal in slurry pipelines from mines to generating facilities during western water shortages. Potential water shortage risks to the parties-at-interest were identified and reviewed. It was found that, while each of three pipelines considered originates in an arid western state (Wyoming, Colorado, Utah), the water availability level, water use for irrigation, and the likelihood of local water shortages in the surrounding community varies considerably in each locale. The risks associated with western water use for pipelines fall heaviest on agricultural users who might need such water during water shortage periods. It is concluded that, to mitigate this problem, pipeline companies must analyze their selection of a water source for pipelines more carefully; as a condition of directing this water, they should participate in further water resource development and conservation projects beneficial to the surrounding community, and they should seek to alter adverse public perceptions associated with coal slurry pipelines in the western states. Further, additional study must be made on the hydrologic characteristics of water sources that may be used for pipeline diversions, and on the precedential effect of using Missouri River water for the ETSI pipeline (running from Wyoming's Powder River Basin to Oklahoma, Arkansas, and Louisiana). (Zielinski-MAXIMA)
W82-06365

MUNICIPAL AND INDUSTRIAL WATER DEMANDS OF WESTERN U.S.,
Southern Univ., Baton Rouge, LA. Dept. of Civil Engineering.
E. S. Joseph.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil engineers, Vol 108, No WR2, p 204-216, June, 1982. 4 Fig, 11 Tab, 18 Ref.

Descriptors: *Water requirement, *Industrial water use, *Municipal water, Water demand, Water consumption, Water conservation, Water use, Western states, Prediction, Energy, Mining, Arid lands.

Water requirements for the western U.S. are separated into residential, municipal and industrial uses. In 1980 the average per capita residential use in 17 western states was 125 gal per day; average municipal and industrial use, 195 gal per day. The ratio of maximum to average total water use was 1.88. Factors affecting water requirements are population, degree and type of industrial development, level of economic development, climate, metering and pricing, water pressure and leaks, and degree of residential conservation. The ratios of projected water requirements to 1980 requirements for the west as a whole are 1.05 for 1985 and 1.20 for 2000. Similar ratios for industrial water use are 1.08 for 1985 and 1.13 for 2000. Ratios for combined municipal and industrial use are 1.07 for 1985 and 1.16 for 2000. Manufacturing uses 38% of industrial water in the west at present; energy, 43%; and mining, 19%. By the year 2000 mining's share is expected to increase 22% and manufacturing to decrease to 30%. No significant changes are anticipated in per capita municipal water use. Although the industrial sector is expected to save water by conservation, the ratio of consumption (the part of withdrawal which is evaporated) to industrial withdrawal is expected to nearly double (0.26 to 0.49) from 1980 to 2000. The tables in this paper are further subdivided, giving separate listings of the above projections for nine western areas, for residential and commercial-public municipal use, for three types of industries (manufacturing, energy, and mining), and for eight categories of manufacturing. (Cassar-FRC)
W82-06463

RUTLAND WATER NATURE RESERVE: CONCEPT, DESIGN AND MANAGEMENT,
Leicestershire and Rutland Trust for Nature Conservation (England).
T. P. Appleton.
Hydrobiologia, Vol 88, No 1-2, p 211-224, March, 1982. 5 Tab, 2 Fig, 8 Ref.

Descriptors: *Wilderness areas, *Wildlife, *Wildlife habitats, *Conservation, Reservoirs, England, Water supply, Land use, Zoning, Land resources, Project planning, Design criteria, Recreation, Water sports, Forest watersheds, Rutland water, Multipurpose reservoirs.

Practical conservation management has helped to create a nature reserve of international importance for wildfowl at Rutland Water. The reserve is composed of three sections - one with public access, one undisturbed, and one with restricted access for naturalists. Disturbance to the wildfowl was further minimized by separating conflicting recreational activities from animal habitats, by es-

tablishing a 50 meter sanctuary zone around the reservoir, and by constructing special wildfowl lagoons. Reservoir operation must be carefully planned to foster wildfowl populations. (Titus-FRC)
W82-06471

ESCAPING FROM PRISON: AN ECONOMIC REASSESSMENT OF RUTLAND WATER,
Leicester Univ. (England). Dept. of Economics.
P. R. Herrington.
Hydrobiologia, Vol 88, No 1-2, p 27-42, March, 1982. 5 Tab, 30 Ref.

Descriptors: *Economic aspects, *Evaluation, *Water demand, *Public policy, *Reservoirs, Cost analysis, Water rates, Economic evaluation, Economic prediction, Water supply, Water supply systems, Forecasting, Projections, Growth rates, Rutland Water, *England.

Recently in the water industry interest has been growing regarding solutions to the widening supply-demand gaps. In this vein, the 1970 decision to build Rutland Water is reassessed. The reassessment reveals that the expected population growth had been overestimated and the water demand forecasts were inaccurate. In the projections no distinction was made between unmetered and metered consumption. Although very little data was available at the time the construction decision was made, the expectation of rapid population growth at the time was sufficient to lead to the decision to build the reservoir. By 1981 a dramatic reduction in expected population and per capita water supply growth had occurred; had the choice of building a reservoir been faced in 1981, the decision would probably have been not to build. (Titus-FRC)
W82-06479

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,
North Yorkshire County Council (England).
For primary bibliographic entry see Field 6B.
W82-06480

RUTLAND WATER - FROM CONCEPTION TO OPERATION,
Anglian Water Authority, Leicestershire (England).
E. A. Knights.
Hydrobiologia, Vol 88, No 1-2, p 7-17, March, 1982. 1 Tab, 4 Fig.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, *Public opinion, England, *Project planning, Evaluation, Water supply, Water demand, Public policy, Water policy, Construction, Rutland Water, Multipurpose reservoirs.

Rutland Water was planned in the 1960s to meet the water needs of the East Midlands region of England. Chosen from 64 possible sites, it was approved in 1970, subject to the following restrictions: (1) the economic burden should not fall entirely on the local ratepayers; (2) perimeter lands should be returned to agricultural use; (3) new roads and services should replace those lost to flooded areas; (4) adequate compensation flow was required in the river below the dam, and (5) the character of the landscape and the rivers involved should be retained. Construction began in 1971 and filling of the reservoir began in 1975; pumping from the rivers began in 1976; the reservoir was completely filled by 1979. It requires relatively little maintenance, although siltation has produced colonies of submerged plants in some areas and erosion has occurred at the margins of the reservoir. Recreational uses of the reservoir--especially fishing and sailing--are integrated with its water supply function. (Titus-FRC)
W82-06481

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,
Policy Sciences Associates, Boulder, CO.
For primary bibliographic entry see Field 3D.
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 3D.
W82-06705

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,
Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
E. W. Clyde.
Natural Resources Lawyer, Vol 14, No 3, p 519-540, 1982. 48 footnotes.

Descriptors: *Water rights, *Energy, *Water allocation, Water storage, Water conservation, Water transfer, Water supply, Water law, Legal aspects, Water management, Appropriation, Permits, Industrial water, Irrigation water, Excess water, Institutional constraints, Interbasin transfers, Contracts, Public rights, State jurisdiction.

The large quantities of water required for energy development in the western U.S. may be obtained by several means. This paper reviews the historical development of water rights and the changing allocation system. Statutes are beginning to recognize public interest as a significant factor in assigning water rights. 'New' water available during high water in random years may be stored under a permit system. Good management of surplus flows can also produce 'new' water, for example, using excess surface water during wet years instead of pumping groundwater. Water shortages can be created by legal constraints: prohibition of interbasin and interstate transfers, legislative control of large appropriations, and legal uncertainties such as Indian water rights and the ownership of wastewater effluents. There are several ways for energy companies to assemble water rights for a large project--purchase of early priorities, storage in underground basins or reservoirs, contracting to buy water when needed, replacing lost crops during dry years in exchange for primary water rights, building storage or improving irrigation efficiencies for local farmers, and direct purchase of water with no conditions attached. (Cassar-FRC)
W82-06839

6E. Water Law and Institutions

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,
Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 119-138, January, 1982. 1 Fig, 12 Ref.

Descriptors: Legal aspects, Water resources development, *Groundwater management, Water supply, Water demand, Regulations, Management.

The search for and extraction of groundwater supplies has been of interest only in recent times. Man is waking up the disastrous consequences of unrestrained groundwater use and abuse. The essentials of traditional groundwater law are reviewed. The widespread agreement among specialists that underground water law and administration should now be treated as part of all freshwater resources law and administration has more meaning than simply the placement of the ground water rules in the same law or regulatory document where surface water norms are found. It means that the same basic development, use and conservation policies should be applied to the resource as a whole. Identical treatment in the law and regulations is not intended. Integrated management is sought in order to achieve the optimum sustained yield of a nation's total water resources. Peculiar physical incidents in the appearance, movement and availability of groundwater that require special regulations and a particular administration are noted. Even so, the makers of development and environmental protection policy need to have at their disposal the entire picture of the quality and quantity of the water resources within their jurisdiction, including underground water resources, and to be able to work toward optimum use of the whole, without major sacrifice of other values enshrined in the community they serve. (Baker-FRC)
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
A. E. Utton.
Natural Resources Journal, Vol 22, No 1, p 95-118, January, 1982. 88 Ref.

Descriptors: *Legal aspects, *Groundwater management, Legislation, Regulations, Water demand, Water resources development, *International law, International agreements.

Increasing demands on water supply and a lack of adequate laws and legal institutions for the management of groundwater or the resolution of disputes will lead to problems in the future. Increased population means increased competition for water. While the United Nations reports that there is no actual physical global shortage of water, there is an uneven distribution of the resource. It is imperative that available supplies be managed prudently and utilized efficiently. The laws governing groundwater nationally are inadequately developed. Developments in national groundwater law are reviewed, along with developments in transboundary groundwater law. Recommendations are offered for the management of transboundary groundwaters. Some management alternatives are offered, including equitable apportionment, case-by-case negotiation, comprehensive management, the allocation process, and studies of water quality. (Baker-FRC)
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,
Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 71-93, January, 1982. 62 Ref.

Descriptors: *Legal aspects, *Aquifers, Groundwater, Water resources development, Regulations, *International law, International agreements.

An accounting was made of the efforts exerted to date at the international level, both intergovernmental and nongovernmental, toward consideration of transnational groundwater in conjunction with surface water and within intergovernmental institutions tailored to the purpose. In the future conjunctive use and integrated protection of groundwater and surface water may become a reality, from the planning stage to the delivery of water services. Perceptions at the international level are described as of 1966, when the Helsinki Rules were adopted. International developments since 1966 are noted. Events are noted in the field of groundwater law and administration at the national level. In most countries the legal regimes governing groundwater are still substantially separated from the legislation or case law governing surface waters. Groundwater rights are usually appurtenances to the land, but even where restrictions, including permit systems, have been imposed, the owner of the overlying land still enjoys a preferred position. The trend is clearly in the direction of severing water rights from the property law concept of ownership in the classical, strict sense. Surface waters nearly everywhere today are subject to significant use regulation. The growing willingness of communities to exercise some control over groundwater can be seen in the widespread, quantitative limitations on pumping. (Baker-FRC)
W82-05940

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,
J. Pruett.
Natural Resources Journal, Vol 22, No 1, p 243-245, January, 1982. 12 Ref.

Descriptors: *Water pollution control, *Legal aspects, Wastewater discharge, Legislation, Jurisdic-

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tion, Legal review, *Shenango River, *Pennsylvania.

A citizens' suit was filed in federal district court pursuant to the Federal Water Pollution Control Act. The complaint in this suit alleged that members of the Board of the North and South Shenango Joint Municipal Authority and various conctractors and construction corporations were releasing untreated sewage into the Shenango River and its tributaries. Eventually the court found that the Authority had violated state discharge limits and ordered the Authority to prepare a timetable containing plans to reduce its discharge to legal limits. There was lengthy discussion that proper notice had not been given, and the defendants argued for dismissal on those grounds. However, the courts followed a broad interpretation of the absolute notice requirement. In the exercise of the court's discretion, however, it had closely followed the legislative intent behind the notice requirement. All defendants had time to investigate the alleged violations and correct them, or to prepare a defense. This approach should be followed in other courts, as it both satisfies legislative intent and also conserves judicial resources. (Baker-FRC)
W82-05986

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,
Nairobi Univ. (Kenya). Inst. for Development Studies.
C. O. Okidi.
Natural Resources Journal, Vol 22, No 1, p 161-199, January, 1982. 192 Ref.

Descriptors: *Water resources development, *Treaties, Legal aspects, Legislation, International agreements, *Nile River, *Lake Victoria, Drainage basins, Consumptive use, Africa, Water use, Planning.

All of the states sharing the Nile and Victoria basins have achieved political independence since 1960, yet there have been no agreements concluded since that time on the uses of the Nile. Since 1960 the range of uses to which the water is put presumably has increased, and there may be many plans under consideration for still wider water usage, so that the safeguards in the pre-1960 treaties will prove inadequate. This paper analyzes the range of instruments that has been signed in an attempt to create cooperation in the consumptive uses of the waters of the Nile Basin, the adequacy of existing treaties to cope with the full range of possible and actual uses of those waters, and some recent developments in terms of actual or planned projects in the basin states, which indicate an urgent need for an up to date framework for dealing with Nile and Lake Victoria waters. Geographical and technical perspectives are considered. Agreements on the Nile and Lake Victoria waters are reviewed, including pre- and post World War I agreements, the Owen Falls Dam agreements, the 1959 agreement for full utilization of the Nile waters, the protocol concerning the permanent joint technical commission, the agreement for the hydrometeorological survey of Lakes Victoria, Kyoga, and Albert, and the agreement for the establishment of the organization for management and development of the Kagera River basin. Post-1959 agreements for Egypt, Sudan, Ethiopia, Tanzania, and Kenya are presented. What seems abundantly clear throughout these agreements is the desirability of a framework for consultation and exchange of information on actual or intended projects involving utilization of the basin waters. (Baker-FRC)
W82-05987

SMALL SCALE HYDROELECTRIC DEVELOPMENT AND FEDERAL ENVIRONMENTAL LAW: A GUIDE FOR THE PRIVATE DEVELOPER,
Boston Coll., Chestnut, MA.
S. H. Burke.
Boston College Environmental Affairs Law Review, Vol 9, No 4, p 815-861, 1981. 315 Ref.

Descriptors: *Hydroelectric power, *Legal aspects, Electric power generation, *Federal jurisdiction, Regulations, Reviews, Licensing, Planning, Water use, Water resources management, Environmental effects.

This article provides a general guide to the major federal environmental laws affecting the planning and construction of hydroelectric facilities and shows how the federal licensing process has been affected by these laws. Each statute is described in sufficient detail to familiarize the reader with the scope and purpose of the law and to allow him to predict generally its impact on a particular proposal. The article is divided into three broad areas: disclosure and consideration of environmental impacts, which describes the role of federal regulatory agencies in the evaluation of the general and resource-specific environmental impacts of proposed hydroelectric facilities before authorizing their construction; federal resource management, which provides for the protection, conservation, and management of particularly sensitive resources; and compliance with licensing procedures to ensure environmental protection. While the development of the hydroelectric potential of the country's rivers and streams will continue to be strongly influenced by the wealth of federal environmental legislation passed in the last two decades, regulatory agencies may not authorize a project before the environmental effects of the facility have been identified and considered. Special attention must be given to preservation of endangered species, fish and wildlife resources and historic resources. Proponents of hydroelectric development should be familiar with the requirements of federal environmental law and should consult with appropriate federal agencies to identify environmental impacts of such facilities. (Baker-FRC)
W82-06002

DISCUSSION ON AN ECONOMIC ANALYSIS OF WATER CONSERVATION POLICY, BY WILLIAM WHIPPLE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman.
Water Resources Bulletin, Vol 18, No 2, p 345-347, April, 1982. 7 Ref.

Descriptors: *Water policy, *Political aspects, *Water conservation, Legal aspects, Economic analysis, Conservation, Reservoirs, Water resources development, Water storage, Dam construction, Legislation.

A comment on the above paper, originally published in Water Resources Bulletin, Vol. 17, No. 5, p 814-819, extends the discussion of the failure of the Carter administration water policy reform proposals. Although the original proposal included groundwater management, fish and wildlife habitat maintenance, and a broadening of management alternatives, halting of construction projects and water conservation were strongly emphasized. A battle developed between congressional committees (in control of water policy for many years) and the administration over the definition of conservation, whether or not conservation included surface water storage. The debate centered on demand reduction (administration) vs. surface storage (opponents), and the two branches of government never arrived at an effective policy reform. The proposed technical assistnace grants program designed to improve the states' water resources planning capacity was eliminated by the Senate because approval would have meant agreement with the administration's definition of conservation. (Cassar-FRC)
W82-06069

APPLICATION PROCEDURES FOR HYDROPOWER LICENSES, EXEMPTIONS AND PRELIMINARY PERMITS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC-0097, April 1982. 192 p, 2 Tab, 2 Append.

Descriptors: *Hydroelectric plants, *Licensing, *Legal aspects, *Permits, Regulations, Construction, Dams, Electric powerplants, Feasibility studies.

The Federal Energy Regulatory Commission assumed most of the responsibilities for regulating non-Federal hydroelectric power projects. The commission issues preliminary permits and licenses, and grants exemptions from licensing for the pprupose of authorizing construction and operation of non-Federal hydroelectric projects. The Commission has revised its regulations to simplify and expedite the hydropower licensing process. The amount of information required for each type of application is directly related to the complexity of the proposed action. The Commission's revised regulations and the basic requirements for filing each type of application are presented. The Commission's regulations provide a range of alternatives for development of a hydropower project. A prospective developer may elect to apply for a preliminary permit, which allows a specific term for the developer to determine the feasibility of developing a hydropower project at a specific site, and to perform studies to support a license application. The Commission's regulations for licensing group proposed projects according to the level of anticipated complexity and potential impact into three categories: major unconstructed projects and major modified projects greater than 5 MW; major projects greater than 5 MW at existing dams; and minor projects and major projects 5 MW or less. The exemption procedure was instituted for small hydroelectirc projects which meet certain characteristics and have an installed capacity of 5 MW or less. (Moore-SRC)
W82-06088

UNITED STATES V. WARD: FWPCA CIVIL PENALTY PROSECUTION, NOT A CRIMINAL CASE FOR THE FIFTH AMENDMENT,
M. G. Grace.
Columbia Journal of Environmental Law, Vol 8, No 1, p 115-135, 1981. 129 Ref.

Descriptors: *Water law, *Environmental protection, *Civil law, *Federal jurisdiction, *Judicial decisions, Legal aspects, Case studies, *Water quality standards, Civil defense, Water pollution control, Jurisdiction.

The Federal Water Pollution Control Act (FWPCA) is designed to restore and maintain the chemical, physical, and biological integrity of the Nation's water. Under section 1321 of the act, failure to report oil spills or spills involving other contaminants is a criminal offense punishable by a fine of up to $10 thousand and/or imprisonment. In the Supreme Court case of the United States v. Ward, the court had the opportunity to define the constitutional limits on compulsory self-reporting in a leading environmental protection statute carrying a penalty labeled as civil. An in-depth study of section 1321 would have established guidelines for future challenges to the congressional labeling of penalty provisions and prevented trends toward administrative streamlining which endangers the right against self-incrimination. Instead, the Supreme Court ignored the guidance laid down in an earlier case and subordinated the rights of individual defendants by upholding the civil penalty feature of the act and denying offenders the rights accorded to criminal offenders. (Geiger-FRC)
W82-06181

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,
San Francisco Bay Inst., CA.
W. T. Davoren.
Coastal Zone Management Journal, Vol 9, No 2, p 111-153, 1982. 2 Fig, 61 Ref.

Descriptors: *Bays, *Water resources development, Water supply development, San Francisco Bay, California, California Coastal Act, Legal aspects, Legislation, Planning.

In 1968 the attention given to the problems of San Francisco Bay was reaching its peak. The California Coastal Commission was established in 1966, and in 1981 it was again before the Legislature for fine tuning. However, the San Francisco Bay area was not included in the more rigorous requirements which were applied to the coast from 1973

to 1976, nor in the 1976 Coastal Act. At present the Bay Conservation and Development Commission is directed to rely on the Federal Coastal Zone Management Act's consistency features to overview the Corps of Engineers' actions on permits in many areas. Much of the history of California revolves around water and its development for man's use. Much of the history of California revolves around water and its development for man's use. Two giant public water development projects, one federal and one state, have dominated California water issues since the 1930s. These were the Central Valley Project of the Bureau of Reclamation and the State Water Project. Both the state and federal projects are readying for a new round of expansion. State water politics are currently dividing along lines that define its seven or more water regions. Several studies have been made of the bay's progress and prosperity, including the Reber Plan, the SERL Studies, Kaiser Engineers Report, and others. During the period of deep environmental concern of the 1970s, little was accomplished as far as the San Francisco Bay's predicament is concerned. Two federal projects, the super dam and the drain, will have great influence in the future on the Bay area. A brief summary of what the Bay's own agencies have been doing is presented. (Baker-FRC)
W82-06182

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,
O'Melveny and Myers, Los Angeles, CA.
O. Olpin, and B. H. Thompson.
Natural Resources Lawyer, Vol 14, No 4, p 635-654, 1982. 44 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, Federal jurisdiction, Public rights.

Two distinct types of legal problems may emerge in geothermal developments: the need to seed water from outside the geothermal system for cooling and other uses, and the need to produce geothermal fluids as the transfer medium for the heat energy. Various approaches to the second type of problem are reviewed, problems associated with the fluids, in liquid or gaseous form, produced by geothermal wells. A brief survey of western water law is presented, concerning both surface and groundwater. Problems for hydrothermal systems using groundwater arise through the need to abide by state water laws which may have been designed for other contexts and thus call for inappropriate procedures. Even more significant problems arise from various state rules and regulations designed to protect prior appropriators' groundwater sources. The geothermal developer may find that the desired development is in a designated critical basin or is connected to an aquifer that is being depleted. Under these conditions it will be difficult to obtain an appropriation permit, at least for the amount of fluids that he foresees his development will need. In many states it is also necessary that the proposed appropriation be in the public interest, which may mean that the developer will have to convince another layer of the state government that the development is in the public interest as that agency sees the situation. The doctrine of 'developed water' may be helpful in some states, as one who develops water which would not otherwise have been generally available is entitled to appropriate the water without regard to normal state water rules. The use of Federal reserved water rights may also be helpful. Several recommendations are offered to ease the situation for geothermal entrepreneurs. (Baker-FRC)
W82-06218

IMPLICATIONS FOR THE WATER INDUSTRY OF THE NOTIFICATION SCHEME FOR NEW CHEMICALS,
Department of the Environment, London (England).
N. J. King.
Water Pollution Control, Vol 81, No 2, p 245-254, 1982. 5 Ref.

Descriptors: *Data collections, *Chemical compounds, Chemical properties, Toxicity, Solubility, Permeability, Chemical reactions, Environmental effects, International commissions, International agreements, Legal aspects.

The notification scheme for new chemicals requires that all new chemicals with a sale of greater than 1 tonne per year must be reported to the national competent authority, including information in the notification regarding use, production level, properties, and special handling, storage, labeling and disposal requirements; that the competent authority may require additional information at any time but must consider the need for such information as various levels of production and sales are reached; that certain categories of substances are exempted and others are already subject to similar directives under other laws; as well as additional requirements. While the directive requires the Commission of the European Communities and the member states to keep confidential information secret, the final decision on what is confidential rests with the compent authority. At its simplest, the scheme is a means of monitoring industry's compliance with the general duties to take steps to ensure the safety of its products and to protect the environment. As the information accumulates, it would in time serve as an invaluable source of data should an emergency occur. Others in the water industry, for example, may need information on toxicity, degradability, or other properties of chemicals and would now be able to secure such information. Such an accumulation of substance-related information is also likely to be a valuable tool in developing knowledge of structure-activity relationships, particularly if it can be linked to data collected in the field. In this respect the water industry may be able to contribute field experience, (Baker-FRC)
W82-06261

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5E.
W82-06291

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,
By K. McCray.
Water Well Journal, Vol 36, No 6, p 42-43, June, 1982.

Descriptors: *Groundwater management, *Legislation, Water pollution control, Water resources development, Mining wastes, Hazardous wastes, Legal aspects, Water conservation, Drinking water.

The use of the nation's groundwater resources has been significantly affected by five items of federal legislation. The Clean Water Act was in reality a series of 1972 amendments to the Federal Water Pollution Control Act of 1948 whose main objective was to protect surface water. With its emphasis on surface waters, the Act has been thought to have increased groundwater pollution by diverting pollutants from surface waters to the ground. The Safe Drinking Water Act of 1974 was created to protect the drinking water supplies by providing for the establishment of primary and secondary standards for levels of contaminants in water supplies, the creation of an underground injection control program, and the protection of soil-source aquifers. The Resource Conservation and Recovery Act of 1976 is the federal government program for managing solid wastes and hazardous wastes that may significantly contribute to serious illness or that may impose a hazard to human health or the environment when improperly managed. The Surface Mining Control and Reclamation Act of 1977 is intended to prevent imminent danger to the health and safety of the pubic or harm to land, air or water resources resulting from both surface and underground mining operations. The Comprehensive Emergency Response, Compensation and Liability Act of 1980 expands the federal government's response authority to hazardous waste dangers to include pollutants or contaminants which may present an imminent and substantial danger to the public health or welfare. (Baker-FRC)
W82-06295

GROUND WATER LAW IN PUERTO RICO.
Water Well Journal, Vol 36, No 6, p 64-66, June, 1982.

Descriptors: *Groundwater management, *Legislation, *Puerto Rico, *Groundwater protection, Groundwater pollution, Water resources development, Water pollution control.

In 1981 the Rio Piedras Agricultural Station published a first inventory of wells to have been conducted in Puerto Rico. The inventory provides hydrometric information on spring and well water for wells within the jurisdiction of the agricultural station. The residents of rural areas may be the largest users of well water. Puerto Rico has laws for protecting the purity of groundwater. In 1948 the groundwater was felt to be of a quality generally safe to drink, whereas most of the surface waters were polluted and unsafe to drink without prior treatment. Until a few years ago Puerto Rican groundwater had no legal institutional framework to guide its management. No state agency was authorized to control water extraction wells. There was no clear definition of functions and responsibilities related to groundwater. In 1972 the Natural Resources Law created the Department of Natural Resources and transferred most powers and responsibilities to it, including the granting of permits for water use and for drilling of water wells. In 1976 the Law for the Conservation, Development and Utilization of Water Resources in Puerto Rico made waters and water bodies public wealth, and the government was entrusted with managing and protecting this national wealth. The Department of Natural Resources is the agency responsible for monitoring the extraction rate of groundwater, the recharge rate of the aquifers, the reduction of the phreatic level and possible contamination of the aquifers. The Environmental Quality Board is responsible for the preparation and publication of groundwater regulations and standards. The Department of Health protects the purity of the water supplies through monitoring. The Aqueduct and Sewer Authority plans, designs and builds drinking water treatment plants and facilities to serve residential, industrial and commercial areas. The United States Geological survey operates observation wells to detect saline intrusion problems and has performed the majority of the groundwater studies in Puerto Rico. (Baker-FRC)
W82-06296

GROUND WATER AND THE STATES,
By K. McCray.
Water Well Journal, Vol 36, No 6, p 47-50, June, 1982.

Descriptors: *Groundwater management, *Legislation, Legal aspects, Groundwater pollution, Aquifers, *State jurisdiction, Water pollution control, Regulations.

A sampling of legislation that has been or is being considered for the use and protection of groundwater is offered. Other regulatory actions that have taken place in some states are also cited. In Arizona a ruling was made which upheld the constitutionality of the 1980 Ground Water Management Act. In Colorado consideration is being given to a bill that would require persons owning water rights to register such ownership and a current address with the state engineer. In Iowa the Natural Resources Council has called for requirements that specify the need for embankments around quarries to block runoff and for test wells around a quarry to monitor the quality of nearby groundwater. In Kansas the Governor has recognized the state's efforts to control water supplies with a new statewide plan for management of groundwater quality. In Louisiana the water laws are under study regarding ownership, water rights, regulation of chemical waste injection wells, protection of drinking water, and other aspects of water control. In Massachusetts reaction was favorable to increased federal protection of Cape Cod drinking water sources. In Michigan after three years of rejection the Joint Administrative Rules Committee adopted the latest draft from the Department of Natural Resources for compliance with the Solid Waste Management Act, signed into law in 1978.

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Mississippi is considering new injection well regulations. Montana has a proposed regulation aimed at preventing aquifer pollution from mining, industrial, municipal and private sources. Nebraska is tightening state policies on reusing irrigation water. New York is studying groundwater use and distribution. Oregon exempted pump installers from registering under various conditions. Laws being considered in Pennsylvania, Rhode Island, South Carolina, Virginia, West Virginia, and Wisconsin are also briefly noted. (Baker-FRC)
W82-06297

GROUNDWATER POLICY: A PATCHWORK OF PROTECTION,
Environmental Law Inst., Washington, DC.
A. Horne.
Environment, Vol 24, No 3, p 6-11, 35, April, 1982. 1 Fig, 71 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Legal aspects, *Water pollution control, *Legislation, *Water policy, Water resources development, Groundwater, Regulations, Water management, Local governments, Environmental control, Environmental protection.

The existing legal framework for groundwater protection has come under attack in recent years. This article focuses on the legal framework for groundwater protection rather than on the problem itself. Each of the federal statutes pertaining to groundwater protection (Federal Water Pollution Control Act Amendments of 1972, Safe Drinking Water Act of 1974, Toxic Substances Control Act, Resource Conservation and Recovery Act of 1976, and Surface Mining Control and Reclamation Act of 1977) is briefly described and a summary of state laws is provided. EPA proposed policies for groundwater management assume that federal, state, and local governments already possess sufficient authority and resources to protect existing supplies. Response to these policies have been mixed, with industries declaring the regulations too stringent and environmentalists claiming they are too weak. In 1981, task groups were formed to review groundwater problems. Unresolved issues consist of deciding on the level of water quality desired, relegating authority among federal, state, and local governments, finding proper strategies for the monitoring of groundwater supplies, translating a desired level of protection into specific regulatory tools, and finding methods of land use controls to protect recharge zones. (Geiger-FRC)
W82-06411

OCEAN DUMPING BATTLE MARCHES ON,
For primary bibliographic entry see Field 5E.
W82-06490

LANDSPREADING OF SLUDGE IN NEW YORK STATE,
For primary bibliographic entry see Field 5E.
W82-06557

MINERAL LAW SINCE NEPA,
Bureau of Land Management, Boise, ID. Idaho State Office.
T. S. Maley.
Idaho Law Review, Vol 18, No 1, p 73-95, 1982. 149 Ref.

Descriptors: *Legislation, *Minerals, Legal aspects, Environmental effects, Watershed protection, Water pollution prevention, Mining, Industrial wastes.

The primary purpose of this article is to identify and describe most of the major legislative and regulatory programs established since the National Environmental Policy Act of 1969 was put into effect that will significantly affect the future of exploration, mining and ore processing operations. In addition to the multitude of environmental laws designed to protect air and water quality, solid waste management, endangered species and cultural resources during this period, there have been several major new leasing programs covering geothermal resources, coal, outer continental shelf oil and gas, and deep seabed hard minerals. Specifically, discussion is offered on public land withdrawals including roadless area review and evaluation programs; environmental laws including the coastal Zone Management Act of 1972, the Resource Conservation and Recovery Act of 1976, water quality reviews, the Uranium Mill Tailings Radiation Control Act of 1978, air quality reviews, endangered species act, cultural resources, and state environmental law and zoning; mine land reclamation and mine safety and the mangement of minerals aquired by lease or permit. The geothermal steam act is discussed as it permits leasing of geothermal resources in federal lands. (Baker-FRC).
W82-06582

ORGANIZATIONAL AND POLITICAL CONSIDERATIONS IN THE MUNICIPAL DEVELOPMENT OF SMALL HYDROPOWER,
Maine Office of Energy Resources, Augusta.
P. A. Heidell, and P. H. Kirshen.
Water Resources Bulletin, Vol 18, No 1, p 105-110, February, 1982, 9 Ref.

Descriptors: *Hydroelectric power, *Local governments, *Political aspects, Dams, Public participation, Political constraints, New England.

There is considerable potential for small-scale hydroelectric power development at existing dams in New England, where over 10,000 dams are currently in existence. Although small-scale hydroelectric powerplants have many economic and environmental advantages, a variety of constraints may hinder development efforts. Efforts by three New England municipalities in unique positions to develop hydropower demonstrate the role of organizational and political considerations in development. Organizational elements and political processes which were integral to the success of these development efforts included cooperation and interaction among citizens, government, and the private sector; community interest and education; and strong resolve. Government support and a social, political, and institutional atmosphere conducive to public development of energy resources were also necessary. Information dissemination and citizen education efforts were found to be crucial factors, especially in municipalities requiring majority approval for municipalization, acquisition of facilities, and grant and loan applications. State and Federal governments can, and do, both assist and hinder a municipality's efforts to develop hydroelectric power. (Carroll-FRC)
W82-06588

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,
For primary bibliographic entry see Field 5E.
W82-06598

WHO OWNS NEBRASKA'S GROUND WATER,
Nebraska Univ. Lincoln.
J. Fussell.
Water Well Journal, Vol 36, No 6, p 44-46, June, 1982.

Descriptors: *Groundwater *Legal aspects,*Ownership, *Nebraska, Supreme Court, Public policy, Policy making, Water policy, Public lands, Public rights, Irrigation, State jurisdiction.

The question of ownership of groundwater in Nebraska becomes more important each year as greater demands are placed on the dwindling supply. Much of the state is underlain by the Ogallala aquifer, one of the largest natural underground reservoirs of water in the nation. Interpreters of Nebraska law indicate that this question falls between the so-called English Rule and the modified American Rule. Under the former rule, the rights to the groundwater belong to the owner of the overlying land. The latter rule holds that the owner of the land is entitled to appropriate subterranean waters found under his land, with the provision that he cannot appropriate such water in excess of a reasonable and beneficial use upon the land he owns, especially if such use is injurious to others who have substantial rights to the water. If the natural underground supply is insufficient for all owners, each is entitled to a reasonable proportion of the whole. On May 1, 1981 the Nebraska Supreme Court filed an opinionin the Douglas vs Sporhase case. Their decision was hailed as unanimous support for the view that groundwater is a public resource. The impact of this decision wil be felt beyond the borders of Nebraska. Not only may its conclusions be cited as legal precedent, but also its reasoning and even the directness of its language incorporated in the court's opinion may be borrowed by persons in various other states. One effect will be to buttress conservation measures in Nebraska and to further sensitize irrigators to the interests of the public. This case has been referred to the US Supreme Court and is being heard under the heading of Sporhase and Moss vs. State of Nebraska, a decision is expected in the summer of 1982. (Baker-FRC)
W82-06819

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,
Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
For primary bibliographic entry see Field 6D.
W82-06839

6F. Nonstructural Alternatives

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,
California Univ., Los Angeles.
For primary bibliographic entry see Field 3D.
W82-05922

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
K. W. Muckleston, M. F. Turner, and R. T. Brainerd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243536, Price codes: A05 in paper copy, A01 in microfiche. Report WRRI-73, December, 1981. 77 p, 10 Fig, 5 Tab, 33 Ref. OWRT A-054-ORE(1).

Descriptors: *Flood plain management, *Land appraisals, *Regulations, *Environmental effects, *Property value, Flood plain zoning, Flood plains, Flow channels, Land management, Legal aspects, Political contraints, Economic aspects, Political aspects, Social aspects, Real property, *Oregon.

A study was made of floodplain regulation impacts on western Oregon residential land values, hypothesizing that the mean rates of appreciation for regulated lands would be significantly less than for similar proximate unregulated lots. Six study areas were used to test this hypothesis, with the finding that the hypothesis could be rejected in most cases. Where the hypothesis was acceptable, flood damage (rather than floodplain regulations) appeared to be the cause. The hypothesis converse was not uncommon: the mean appreciation rates for regulated land increased significantly faster than for unregulated control parcels. It was concluded that this probably reflects the amenity values of waterfront properties and the recent marked improved water quality of the Willamette River. Hence, most of the evidence of this 6-site study suggests that floodplain regulations have not had a significant negative impact on residential land values. Limitations to this study, carried out under less than ideal conditions, which restrict the attainment of final conclusions are discussed. Nonetheless, the study data illustrate that floodplain regulations do not appear to play an important role in the assessment process. (Zielinski-MAXIMA)
W82-05930

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,
Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
For primary bibliographic entry see Field 2E.
W82-05997

MANAGING FLOOD RISK: TECHNICAL UNCERTAINTY IN THE NATIONAL FLOOD INSURANCE PROGRAM,
Bracken and Baram, Boston, MA.
M. S. Baram, and J. R. Miyares.
Columbia Journal of Environmental Law, Vol 7, No 2, p 129-164, 1980. 132 Footnotes.

Descriptors: *Flood plain management, *Insurance, *National Flood Insurance Program, *Risks, *Flood plain zoning, Nonstructural alternatives, Mapping, Surveys, Land use, Decision making, Federal Emergency Management Agency.

The National Flood Insurance Program (NFIP), established in 1968, seeks to control the risk of flood damage by encouraging local government to control land use. Two problems, both attributable to technological uncertainties and changing circumstances, have emerged under the NFIP. First, restudies of a community's flood risk, etc. have used increasing amounts of the total study funds. There are no clear guidelines for determining if a restudy is justified. Second, new technical developments in flood plain mapping and risk prediction are continually being made. It is difficult to determine when new methods should be adopted. Restudies may be necessary because of scientific or technical error, the sudden availability of new data (such as an unprecedented flood), judicial mandate, or community request. This paper proposes that criteria be articulated to guide the Federal Emergency Management Agency (FEMA) in deciding when restudies should be undertaken or new study methods adopted. Several objective, generic criteria suggested by an FEMA contractor are presented as a basis for developing a structured system to decide the need for restudy. They include: extension of study areas, revision of base data, and update of prior studies due to improved methods. (Cassar-FRC)
W82-06073

OFFICIAL AND FOLK FLOOD WARNING SYSTEMS: AN ASSESSMENT,
National Center for Atmospheric Research, Boulder, CO.
R. Schware.
Environmental Management, Vol 6, No 3, p 209-216, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Flood protection, *Warning systems, West Bengal, *India, Floods, Warning systems, Developing countries, Regional development.

The inadequacies of the flood warning system became clear recently in West Bengal, India. Some socioeconomic constraints on the communication of flood warning messages are reviewed. Perceptions of, and responses by, villagers in a flood prone region of West Bengal to official and to folk flood warnings are considered. Most of the major flood-producing rivers originate beyond the jurisdictional limits of West Bengal. Thus to a large extent this riparian state is at the mercy of policies of flood control, water utilization and soil erosion of the neighboring states of Bihar and Assam as well as of Nepal, Bangladesh, Bhutan, and Sikkim. Flooding results from reduction in the drainage capacity of rivers due to excessive sedimentation, breaches in the Zamindari embankments, incomplete construction of new embankments, lack of maintenance of excavated drainage channels, and blockage of inland stream flow by sea tides. Individual responses to flood warnings are conditioned by age, educational level, cultural background, and knowledge or experience of previous situations. Both the increasing encroachment of population into low and alluvial lands of the lower Damodar Valley and the piecemeal attempts to control floods in the region since independence have given rise to problems that affect agricultural production, health, and industrial development. Flood warning messages are not always effectively disseminated to flood-affected communities. At least some reappraisal of the existing approach to flood warnings should be considered. (Baker-FRC)
W82-06077

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06128

WORK MANAGEMENT STANDARDS,
Tampa Water Dept., FL.
D. L. Tippin, and G. M. Barron.
Journal of the American Water Works Association, Vol 74, No 6, p 292-295, June, 1982. 1 Fig, 2 Tab.

Descriptors: *Management planning, *Water supply, Water demand, Tampa, *Florida, Planning.

The Tampa, Florida, Water Department designed and implemented a systems approach to management effectiveness in water services based on standards for both service levels and performance in order to incorporate accountability for the relationship between service provided and dollars spent. Standards provide control for the work management system. They control the kinds and amounts of work performed on each activity through the performance standards established. By defining specific resources, standards allow estimation of the resources needed to complete the goals as outlined by the policy makers. By reporting work accomplished, data are accumulated for the next year's budget, adherence to the current budget is monitored, and the utility is able to determine whether resources are being used effectively. Prior to the distribution division's developing performance standards, maintenance employees were about 30-40% effective in their work performance. It is now estimated that they are more than 70% efficient and show continued improvement. Crew size on all major crews has been reduced by careful analysis of the manpower needs for each activity, and cost savings have resulted from the increased production and work method improvements. (Baker-FRC)
W82-06349

FLOOD RISK PERCEPTIONS AND OVERDEVELOPMENT IN THE FLOODPLAIN,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and W. L. Miller.
Water Resources Bulletin, Vol 18, No 1, p 89-94, February, 1982. 2 Tab, 21 Ref.

Descriptors: *Flood plain management, *Floods, *Risks, Social aspects, Land development, Land use, Land appraisals, Insurance, Economic aspects, Flood damage, *Indiana.

There is a long-standing hypothesis that imperfect information about potential flood hazard, an exception of liberal disaster relief, and anticipation of future structural protection have resulted in overdevelopment of the nation's flood plains. Data for a case study area--Logansport, Indiana--were analyzed using multiple regression techniques in an effort to investigate this hypothesis. The effect of the introduction of the National Flood Insurance Program (NFIP) on residential property values was investigated in order to determine whether flood plain residential property values were fully discounted for expected flood damages. The case study analysis showed that residential property values in the flood plain were less than fully discounted for the existing flooding potential prior to the introduction of the NFIP. Such low cost information as lot elevation and distance from the river were found to affect sale price, apparently due to its role in the formation of flooding potential perception. Flood plain management policy alternatives which would provide better information on flooding potential and eliminate the perverse incentives created by the expectation of liberal disaster relief include simple zoning and actuarial insurance. Simple delineation of the 100-year flood plain with zoning restrictions would involve relatively low implementation costs, while the development of actuarially accurate premiums for flood insurance would be relatively costly. In any case, the study results indicate that unless policy changes eliminating the perverse incentives of past policies are adopted, overdevelopment of flood plains will continue. (Carroll-FRC)
W82-06585

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),
Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
D. Kampe.
GWF, das Gas- un Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 30-38, January, 1982. 4 Tab, 22 Ref. English summary.

Descriptors: *Water policy, *Agriculture, *Water management, *Resources management, Public policy, Hydrology, Drinking water, Water quality, Land use, Water resources developement, *West Germany.

The conflict between drinking water procurement and the needs of the increasingly intensified agricultural production in West Germany are discussed. Within the federal government there is a large gap between the officially proclaimed goals of environmental protection within agricultural policy and the actions of that policy. Strategies and instruments for agricultural land use compatible with water procurement are presented. These include planning to determine the suitability of land for specific types of agriculture based on hydroecological mapping, field clearing to match land and agricultural type, the promotion of agricultural businesses prepared to forego intensification and their financial compensation in the case of lost revenues, the laying fallow of land, the building up of an advisory structure particularly for the subjects of fertilizers and pesticides, aid in marketing of goods produced under conditions favorable to water procurement, and development of a national price policy. All these measures should be carried out within the context of water priority areas which already exist in some regions of the country. However, it will be difficult to persuade the government to institute such a program due to the lobbying power of the agricultural industry. (Gish-FRC)
W82-06714

6G. Ecologic Impact Of Water Development

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
R. G. White, J. H. Milligan, A. E. Bingham, R. A. Ruediger, and T. S. Vogel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243478, Price codes: A13 in paper copy, A01 in microfiche. Report, September, 1981. 283 p, 74 Fig, 37 Tab, 124 Ref, 6 Append. OWRT B-045-IDA(1). 14-34-0001-8080.

Descriptors: *Stream discharge, *Hydraulic models, *Model studies, *Instream flow, *Fish populations, Streamflow, Streamflow depletion, Flow discharge, Flow characteristics, Flow channels, Hydraulic similitude, Simulation, Aquatic habitats, Channel flow, Channel morphology, Insect behavior, Population dynamics, Riffles, Fish migration, Trout, Oregon, Grande Ronde River.

A study was made of the responses of aquatic insects and juvenile rainbow-steelhead trout to flow-related changes in habitat, and of the predictive capability of three hydraulic simulation models that are currently used to make instream flow recommendations. Tests were conducted in the spring, summer, and fall in two large near-natural artificial stream channels having run-riffle

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channel configurations: one channel was maintained at constant discharge; flow in the second channel was reduced incrementally. Flow reduction produced increased behavioral/catastrophic insect drift which increased at night and varied with season, degree of flow reduction, and type and developmental stage of aquatic insects. Flow reduction also resulted in decreased trout numbers with large test fish more affected than small fish. It appeared that larger trout responded primarily to physical habitat parameters than to a decrease in food availability. No single hydraulic parameter studied (velocity, depth, surface area, wetted perimeter), consistently correlated with test fish response. Flow-related changes in cover, however, appeared to influence juvenile trout habitat utilization. The hydraulic simulation models tested generally predicted the parameters they were designed for accurately, but the models varied in ease of calibration, application, and useful extrapolation range. It was found that transect placements for hydraulic simulation data collection in run-riffle channels were more important than the number of transects used. (Zielinski-MAXIMA)
W82-05923

CARRYING CAPACITY FOR THE ILLINOIS RIVER,
Oregon State Univ., Corvallis. School of Forestry.
B. Shelby, and R. B. Colvin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243510, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 56 p, 12 Tab, 4 Append. OWRT A-999-ORE(28).

Descriptors: *Wild rivers, *Camp sites, *Public waters, *Carrying capacity, *Frequency analysis, Rivers, Rapid flow, Boating, Boat-launching ramps, Recreation wastes, Navigable rivers, Public access, Public waters, Environmental effects, *Oregon, *Illinois River(Oregon).

A total of 51 miles of the Illinois River in southwestern Oregon has been proposed for inclusion in the Wild and Scenic Rivers system; this study focused on the use of the 29-mile wild section between Briggs and Nancy Creeks for wild river excursions. These trips last from 2-5 days, with an average trip size of 7 persons for private and 11 persons for commercial groups, covering a season from early March to mid-June. The physical capacity of the river is limited by available campsites; ecological capacity particularly concerns human impacts on campsite ecology; social capacity, the limiting factor, focuses on experience factors among groups. The field study measured use levels, encounters among parties, and selected user perceptions. During the mid-April to early June 1979 study period, 50% of the days had no launches, and 59% of launch days were Fridays and Saturdays. With 1 or 2 trips launching per day, party encounters ranged from 0-2/day; with 3-5 launches, encounters increased to 1-3/day. Trips spent an average of 1 of 7 nights (16%) within sight/sound of another party. It was concluded that camp encounters are not correlated with use level; competition for campsites occurs in particular sections of the river, the location of which depends on the length of the trips. (Zielinski-MAXIMA)
W82-05927

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W82-05933

CHINA'S AGRO-ECOSYSTEM,
Manitoba Univ., Winnipeg. Dept. of Geography.
For primary bibliographic entry see Field 3B.
W82-06019

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Washington, DC.
Report DOE/EIS-0082, February, 1982. 575 p, 31 Fig, 104 Tab, 221 Ref, 17 Append.

Descriptors: *Radioactive waste disposal, *Environmental effects, *Environmental impact statement, *Underground waste disposal, Wastewater treatment, Sludge disposal, Waste disposal, Radioactive wastes, *South Carolina, *Savannah River Plant.

The Savannah River Plant is a major installation for the production of nuclear materials for national defense. Approximately 8300 cu m (22 million gal) of high-level radio-active waste (HLW) are currently stored in tanks at the plant. The purpose of this study is to provide environmental input into both the selection of an appropriate strategy for the permanent disposal of the HLW currently stored at the plant and subsequent decision to construct and operate a Defense Waste Processing Facility (DWPF) at the Savannah River Plant site. The proposed DWPF would process the liquid HLW generated into a stable form for ultimate disposal. The HLW is composed of three components: an insoluble sludge 15%; a crystallized salt cake (60%); and a supernatant aqueous solution (25%). The preferred alternative for disposal of the HLW is geological disposal or long-term isolation in a mined geologic repostitory, with very deep hole and subseabed disposal being retained as backup technologies. The proposed DWPF will immobilize the waste into an appropriate form for placement in a repository. Three immobiliazation alternatives were analyzed in detail to show the possible range of environmental impacts associated with the construction and operation of a DWPF. All three immobiliaztion alternatives require the processing of the waste into two fractions: a high-level raioactivity fraction for immobilization and offsite geologic disposal and a partially decontaminated salt fraction for solidification and disposal as low-level waste on the site. The preferred alternative is the staged process alternative in which a facility to treat the sludge would be constructed first, and then a facility to treat the salt cake and supernatant would be constructed. (Moore-SRC)
W82-06087

EVALUATION OF IMPACTS ASSOCIATED WITH REREGULATION OF WATER LEVELS IN LAKE MOHAVE,
Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 4, March 1980. 23 p, 8 Fig, 4 Tab, 8 Ref. 14-06-30002218.

Descriptors: *Lake Mohave, *Reservoir releases, *Water level fluctuations, *Thermal stratification, *Fish populations, *Environmental effects, Hoover Dam, Recreation, Water temperature, Plankton, Hydroelectric plants, Reservoir operation, Reservoir fisheries, *Nevada.

The Water and Power Resources Service is considering reregulating Lake Mohave water levels to increase the net power benefit from Hoover Dam. By generating more power during those periods when energy has a higher market value, more net monitary benefit can be derived. To optimize power generation from Hoover Dam, water levels will fluctuate from elevations of 600 to 640 ft. The proposed alternatives will increase the instability of Lake Mohave, which in turn will affect every component of the biota. It is reasonably certain that the largemouth bass fishery will decline as a result of the reregulated water levels. The lower water will also tend to reduce the total carrying capacity of Lake Mohave for all types of fisheries. Fluctuating water levels and high Hoover Dam discharges, during low water levels, will increase the instability in Lake Mohave resulting in partial destratification and cooler water temperatures. Instability will produce changes in the plankton communities, but nuisance conditions will probably not occur due to increased turbulence and lower water temperatures. Cooler water temperatures can be considered a water quality problem because the total area in Lake Mohave available for water contact sports will be reduced. (Moore-SRC)
W82-06089

THE LIMNOLOGICAL STATUS OF LAKE MEAD AND LAKE MOHAVE UNDER PRESENT AND FUTURE POWERPLANT OPERATIONS OF HOOVER DAM,
Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, J. R. Baker, and J. E. Deacon.
Technical Report No 1, January 1980. 229 p, 70 Fig, 27 Tab, 76 Ref. 14-06-300-2218.

Descriptors: *Lake Mead, *Lake Mohave, *Dam effects, *Reservoir releases, Limnology, *Pumped storage, Hydroelectric plants, Reservoir operation, Nutrients, Physical properties, Chemical properties, Plankton, Productivity, Environmental effects, Thermal stratification, Water temperature, Fisheries, *Utah.

Several proposed alternatives for modifying Hoover Dam to increase peak-power output would require a peak discharge in excess of current levels (25-30,000 cu ft/sec). Investigations were conducted on Lake Mead and Lake Mohave to assess the impacts of these power modifications on the limnology of the reservoirs. Temperature, oxygen, pH, conductivity, light, nitrogen, phosphorus, chlorophyll-a, phytoplankton productivity, and plankton species composition measurements were made monthly at 15 reservoir stations in Lake Mead and 5 in Lake Mohave. Nutrients were also measured monthly in the Colorado River at Pierce Ferry and below Hoover Dam and in Las Vegas Wash. Upgrading of existing generating units or addition of new units will require an increase in peak-discharge to 49,000 and 56,000 cu ft/sec and minimum flows of 2000 cu ft/sec. Alternating high and low discharge will cause an oscillation of the thermocline in Black Canyon, near the dam. At low lake elevations, warmer water will probably be pulled to the intake gates, increasing the temperatures of the discharge. The alternating high and low discharge will have the greatest impact on Lake Mohave. Thermal stratification will be disrupted, and the interface between river and reservoir water will shift down-lake under high discharge and up-lake at low discharge. Operation of a pump-storage unit at Hoover Dam will require a peak-discharge of 76,000 cu ft/sec, periods of no flow and reverse flows of 25,000 cu ft/sec. Fluctuations in temperature of the river, interspersed with periods of no flow will create problems for recreational use and fisheries in Black Canyon between Hoover Dam and Willow Beach. (Moore-SRC)
W82-06090

INFLUENCE OF DREDGING AND HIGH DISCHARGE ON THE ECOLOGY OF BLACK CANYON,
Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, T. G. Miller, and J. R. Baker.
Technical Report No 1, 1980. 59 p, 16 Fig, 8 Tab, 33 Ref. 14-06-300-2218.

Descriptors: *Forebays, *Dredging, *Environmental effects, *Reservoir releases, *Productivity, Fish food organisms, Dam effects, Hydroelectric plants, Colorado River, Hoover Dam, Pumped storage, Periphyton, Invertebrates, Scour, Silting, Trout, Sucker, Chubs, *Black Canyon, *Utah.

The Water and Power Resources Service is considering dredging in Black Canyon to create a larger forebay to accommodate higher peak-discharges and reverse flows for proposed modifications to Hoover Dam, such as the addition of one or more conventional hydroelectric generating units, and the addition of reversible pump-storage hydroelectric units. The Black Canyon area supports a heavily utilized trout fishery and is important habitat for the razorback sucker and possibly bonytail chub. The food chain in Black Canyon is relatively simple and consists of a few invertebrate and fish species that are wholly supported by periphyton productivity occurring in the canyon. Dredging in the area above Ringbolt Rapids will significantly reduce periphyton and invertebrate productivity, and could reduce the trout and endemic fish populations because they are wholly dependent on these autochthonous resources for

food. Higher current velocities created by increased peak-discharges could have a mre permanent impact than dredging. Siltation occurs below the tailrace during low discharge periods. These materials are flushed downstream during peak-discharge periods and scour the bottom of periphyton and invertebrates. If dredging is conducted, consideration should be given to disposal of dredge spoils (cobble and boulder size) along the river banks in Black Canyon, since boulder and cobble substrate would probably enhance productivity. (Moore-SRC)
W82-06091

EVALUATION OF POSSIBLE TEMPERATURE FLUCTUATIONS FROM PROPOSED POWER MODIFICATIONS OF HOOVER DAM,
Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 3, March 1980, 23 p, 10 Fig, 2 Tab, 4 Ref. 14-06-30002218.

Descriptors: *Water temperature, *Dam effects, *Environmental effects, *Pumped storage, *Reservoir operation, Reservoir releases, *Hoover Dam, Hydroelectric plants, Lake Mead, Thermal stratification, Intakes, *Utah.

Planned alternatives for increasing the generation capacity of Hoover Dam to help meet peak power demands include uprating existing units, adding generating units, and adding reversible pumped-storage hydroelectric units. The upper intake gates (1045 ft), with few exceptions, have not been used since 1954, but with the addition of generating units or the installation of reversible pumped-storage units, one upper gate on the Arizona Tower would be used in conjunction with the four lower gates to facilitate the higher flows. In order to evaluate the effects of discharge rate from the upper and lower gates on temperature and temperture structure in Lake Mead, Hoover Dam was alternately operated from the four lower gates and four upper gates in sonsecutive 24-hour periods over the daily power cycles on 18-19 August and 22-23 August 1979. The rate of discharge had no obvious effect on discharge temperatures when either the lower or upper gates were used. The planned operation of using one of the upper gates in conjunction with the four lower gates will cause only a slight increase in discharge temperature. The cumulative effect of continual alternation of pumping and discharging with reversible pumped storage could substantially disrupt thermal stratification in Black Canyon and parts of Boulder Basin. (Moore-SRC)
W82-06092

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,
Windrem, Feeney and Williams, Lakeport, CA.
P. F. Windrem, and G. L. Marr.
Natural Resources Lawyer, Vol 14, No 4, p 675-685, 1982. 1 Tab, 58 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, *California, Geysers, Water quality, Water pollution sources, Environmental effects.

This paper describes the stages of geothermal development, the attendant environmental hazards, and the jurisdictions of the various government agencies. Most examples of environmental hazards are drawn from the electric power production in the geysers of northern California. Major environmental effects of geothermal development are observed on air quality, land (soil erosion, seismic activity and subsidence, wildlife habitat and visual quality), and water quality. In California development occurs on private lands, federal land, federal mineral reserve land, state land, and state mineral reserve land, each subject to different regulatory agencies. Geothermal development occurs in five stages: exploration, full field development, power plant construction, field operation, and field abandonment. Primary threats to water quality are sedimentation of streams from soil erosion caused by earth work, spills of liquid wastes such as drilling fluids and power plant steam condensate, and well casing failure. The most serious incidents of water pollution at the geysers in California have resulted from spills of steam condensate into nearby streams, caused by condensate pond overflow, condensate pipeline rupture, or reinjection problems. The pollution results from the toxicity of the waste water. A number of different agencies have jurisdiction over various aspects of the process. (Baker-FRC)
W82-06217

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.
Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 6B.
W82-06368

THE RELATIVE ABUNDANCE OF OPOSSUM SHRIMP, MYSIS RELICTA, IN TWIN LAKES, COLORADO USING A BENTHIC TRAWL,
Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234493, Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-82-3, September 1981. 25 p, 12 Fig, 5 Tab, 17 Ref.

Descriptors: *Shrimp, *Biological samples, *Sampling, Aquatic populations, Twin Lakes, *Pumped storage, Environmental effects, Benthos, Trawling, Seasonal distribution, *Colorado.

The study of the opossum shrimp (Mysis relicta Loven) at Twin Lakes, Colorado, is part of an investigation into the potential impacts of pumped-storage power generation on the two lakes. Since 1974, large and small benthic sled-type trawls have been used monthly to determine relative abundance of the shrimp. A comparison of the two trawls based on replicate sampling indicated that the mean shrimp density for the large trawl was 68% of the small trawl estimate. This difference was not statistically significant because of a large sample variation. An off-bottom sampling bias affected by the speed of the trawl was determined in a separate study using the small trawl. Corrections for this potential bias in the small trawl data collected in 1977 and 1979 indicated that shrimp densities may have been underestimated by 22 to 77%. Comparison of mean shrimp densities for the two trawl sizes using corrected small trawl data showed the large trawl estimate to be only 42% of the small trawl estimate. Shrimp length frequency analyses concur with this difference, indicating the smaller, juvenile shrimp were missed by the large trawl because of the larger mesh size. Adjusting for trawl sampling efficiency and sampling bias, yearly shrimp densities may have ranged from 88 to 348 shrimp/sq m in the lower lake and from 57 to 174 shrimp/sq m in the upper lake. This sampling variability precluded all but the most general comparisons of Mysis densities. Monthly estimates of shrimp densities in each of 4 years sampled showed a characteristic increase from June to September with declines in October and November in the lower lake. Over the 1974 to 1979 study period, seasonal mean estimates of shrimp density and indicated an increasing abundance of Mysis since 1975 in the lower lake, and a fluctuating population in the upper lake. (Author's abstract)
W82-06399

TWIN LAKES STUDIES: A CHARACTERIZATION OF THE TWIN LAKES FISHERY VIA CREEL CENSUS WITH AN EVALUATION OF POTENTIAL EFFECTS OF PUMPED-STORAGE POWER GENERATION,
Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Bureau of Reclamation Report REC-ERC-82-4, November 1981. 56 p, 12 Fig, 28 Tab, 42 Ref.

Descriptors: *Environmental effects, *Trout, *Lake fisheries, Twin Lakes, *Pumped storage, Fish populations, Sport fishing, Recreation, Fishkill, Turbidity, Water level fluctuations, *Colorado.

Creel census data are presented for the period December 1976 to September 1979. The creel census studies have resulted in estimates of seasonal fisherman effort, harvest, and catch rates with a precision suitable for use in the detection of impacts from the operation of the Mt. Elbert Pumped-Storage Powerplant. For the 1973-79 summer seasons, total fishermen effort estimates ranged from 66,677 to 89,820 man-hours on the lower lake and from 19,721 to 29,139 man-hours on the upper lake. Harvests ranged from 19,955 to 32,496 fish on the lower lake and from 6411 to 12,457 fish on the upper lake. Fifty-four to 56% of the fisherman effort and harvest occurred on weekends. Rainbow trout composed 94% or greater of the summer harvests. For the winter seasons on the lower lake from 1974 to 1979, fishermen effort estimates ranged from 3900 to 8800 man-hours and harvest estimates ranged from 400 to 1200 fish. Lake trout composed 87% or greater of the harvests in most winter seasons. Potential powerplant impacts via increased mortality to rainbow trout, daily and seasonal water-level fluctuations, and shoreline turbidity may have the greatest negative impact upon the Twin Lakes shore fishery for rainbow trout. Because the estimates from the winter harvest, the boat fishery, and the monthly creel census for both shore and boat categories are less precise, only large-scale changes in these components will reflect statistical significance. Operation of the powerplant during the weekends in the summer may have a greater impact on fishermen effort if large-scale turbidity or fishskills are observed. (Moore-SRC)
W82-06401

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES AT TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit., Fort Collins.
E. P. Bergersen, and M. Maiolie.
Bureau of Reclamation Report REC-ERC-82-8, December 1981, 66 p, 40 Fig, 2 Tab, 18 Ref, 1 Append.

Descriptors: *Environmental effects, *Water currents, *Limnology, *Trout, *Water level fluctuations, *Shrimp, *Suspended sediments, *Twin Lakes, *Pumped storage, Monitoring, Water circulation, Spawning, Fish eggs, Eutrophication, Vegetation, Productivity.

The objectives of these studies were to gather baseline data on the Twin Lakes system during the preoperational phase of the Mt. Elbert Pumped Storage Powerplant, and to develop aquatic environmental monitoring techniques suitable for use during post-construction operating periods. Natural, seasonal patterns in surface and bottom currents were characterized and documented in the two-lake system, to allow detection of changes in current patterns produced by the powerplant. Suspected shoreline spawning habitats were searched for lake trout eggs to a depth of 1.5 m in 1979 and 1980. Results indicate that it is unlikely that lake trout in Twin Lakes spawn in water less than 1.5 m deep, and thus the expected daily water fluctuation of 0.7 to 1.1 m should not result in the exposure of lake trout eggs. A photographic method of estimating Mysis shrimp populations was developed. Shrimp are at least 2.4 times as abundant in Twin Lakes as previously thought, with densities in the vicinity of the powerplant as high as 232 shrimp/sq m. Both sediment traps and inflow/outflow suspended sediment sampling were used to estimate sedimentation rates in Twin Lakes. Estimates from these two methods differ greatly. The best time to monitor impacts on sediment movement and deposition would be during the winter months. Potential input to the energy budget from inundated terrestrial vegetation was estimated to be over four times the average annual primary productivity of the system. (Moore-SRC)
W82-06402

ENVIRONMENTAL ASSESSMENT; GEOTHERMAL DIRECT HEAT PROJECT; MARLIN TEXAS.
Department of Energy, Washington, DC.

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Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EA-0117, Price codes: A04 in paper copy, A01 in microfiche. Report DOE/EA-0117, August 1980. 68 p, 11 Fig, 14 Tab, 10 Ref, 2 Append.

Descriptors: *Geothermal resources, *Environmental effects, *Wastewater disposal, *Brazos River, Wells, Water quality, Groundwater pollution, Water pollution sources, Thermal pollution.

The project construction activities consist of well drilling, pipeline construction, heating system modification, and fluid disposal provision for the Torbett-Hutchings-Smith Memorial Hospital to provide an environmentally acceptable, operational geothermal space heating and hot water system. It was necessary to drill one supply well in order to confirm the reservoir and to obtain fluids for analysis in order to assess the environmental effects of fluid disposal. Fluid from operation will be disposed of by discharging it directly into existing street drains, which will carry the fluid to Park Lake and eventually the Brazos River. The spent fluids will be discharged at approximately 50 C and at a maximum of 13 l/s. It is anticipated that because of the utilitarian nature of the City Park Lake, Bean Branch and McCullough Slough; the long-term public use and acceptance of Marlin geothermal waters for bathing and drinking purposes; and the fact that these bodies of water are not used for irrigation, the geothermal discharge will not require pretreatment. No significant effects on water quality in the project area are expected during operation. At minimum flow rate for the Brazos River, the maximum discharge of geothermal water (25 l/s) will increase the river's flow by only 0.26%. The possibility of contamination of aquifers will be minimized through careful design and construction of the well. Depletion or subsidence problems are not likely to occur. The proposed drilling site is in a developed urban area, so no disturbance of natural vegetation or wildlife habitat will occur. (Moore-SRC)
W82-06404

ENVIRONMENTAL ASSESSMENTAL, GEOTHERMAL ENERGY, HEBER GEOTHERMAL BINARY-CYCLE DEMONSTRATION PROJECT; IMPERIAL COUNTY, CALIFORNIA.
Department of Energy, Washington, DC. Div. of Geothermal Energy.
Report DOE/EA-119, October 1980. 314 p, 25 Fig, 18 Tab, 173 Ref, 9 Append.

Descriptors: *Geothermal power, *Environmental effects, *Cooling water, *Injection wells, Wastewater disposal, Irrigation-return flow, Powerplants, Water use, Effluents, Salt drift, Thermal pollution, Irrigation water, Blowdown.

The power plant will utilize a simple binary conversion process consisting of three fluid loops: a geothermal fluid loop, a hydrocarbon working fluid loop, and a cooling water loop. The geothermal well field will consist of a production island with 13 production wells and an injection island with 7 injection wells. A mechanical draft cooling tower using approximately 8.8 cu m/s of cooling water will be utilized. Approximately 0.22 cu m/s of make-up water is required by the project. Water for the first five years of operation will be Colorado River irrigation water obtained from the Imperial Irrigation District. After the initial five years of operation, water will be obtained from the New River, irrigation return flows, or both. The geothermal resource to be developed is located at a depth of 610 m to 3048 m. The available resource is estimated to be 17 cu km at temperatures ranging from 165 C to 182 C. The principal effluents are salt drift and blowdown released from the cooling tower. Geological impacts resulting from the project are gradual reservoir depletion, and displacement of prime farmland soils. Hydrological impacts result from water depletion, effluent discharge, and thermal enrichment. These impacts will be mitigated by compliance with California Regional Water Quality Control Board permit requirements. (Moore-SRC)
W82-06406

GOWANUS CREEK CHANNEL; BROOKLYN, NEW YORK; REVIEW OF REPORTS (SURVEY); MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT.
Army Corps of Engineers, New York.
Report, September 1981. 81 p, 6 Fig, 10 Tab, 25 Ref.

Descriptors: *Dredging, *Channel improvement, *Waterways, *Environmental impact statement, Oil spills, Turbidity, Estuaries, Environmental effects, Sediments, Fish migration, Water quality, Water pollution control, *New York, Gowanus Creek Channel.

The 30 ft mean low water existing Federal navigation channels in Gowanus Creek, Brooklyn, New York, are not deep enough to allow present deep draft and other large ocean-going vessels to use them in a fully loaded condition. The recommended plan consists of deepening the channels to 35 ft below mean low water. Additional dredging from 35 to 40 ft may be accomplished at non-Federal cost. All material would be disposed of in a sanitary land fill in Fresh Kills, Staten Island. The dredging will significantly reduce present navigation problems in this waterway, with minimal adverse environmental impact and an overall net improvement due to removal of polluted bottom sediments from the aquatic environment. It will also reduce the occurrence of oil spills by reducing the lightering of petroleum products. Since Gowanus Creek Channel is impoverished in aquatic and benthic life, and because the surrounding area is devoted to shipping and industrial activities, the environmental impact of dredging will be minimal. An increase in turbidity in Gowanus Bay may marginally interfere with fish migrations. The impact of dredging on the Hudson fishery will be reduced if dredging activities are limited to the late autumn or early winter. Indications are that there will be no change in the tidal dynamics of the creek. (Moore-SRC)
W82-06407

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.
Soil Conservation Service, Boise, ID.
Report, March 1982. 98 p, 23 Fig, 14 p, 34 Ref, 2 Append.

Descriptors: *Channeling, *Stream stabilization, *Environmental effects, *Flood damage, *Aquatic habitats, Invertebrates, Dam failure, Species diversity, Irrigation water, Trout, Productivity, *Idaho, Teton River.

Teton Dam collapsed on June 5, 1976, while it was being filled for the first time. The North Fork of the Teton River was badly damaged by the flooding. In August 1976, water was diverted from the North Fork to facilitate the clean-up operation and restore its capacity for carrying flood flows. The stream-bed remained dry until mid-December when the temporary diversion dam was removed. A study was initiated to determine the effect of the Teton Dam flood and subsequent channel dewatering and channelization on the North Fork. Four stations in the North Fork were established as routine sample locations, plus one station in the main river. Examination of the data on total numbers of benthic invertebrates indicates that at least some parts of the North Fork have recovered. Its failure to do so at one station is due to excessive withdrawal for irrigation and not to factors associated with the flood. Data on the number of taxa suggested that only one station on the North Fork had fully recovered in terms of richness and that the other stations support 8 to 26 taxa fewer than would be expected. Values for richness and diversity did not peak until the second year at the downstream stations. There are steps which could have been taken as a part of the channel rehabilitation project which would have enhanced the rate of recovery and level of productivity. Failure to do so has prevented recovery of this portion of the river even three years later, and the attainment of its full potential as a productive trout stream. (Moore-SRC)
W82-06409

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,
Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
J. E. Peters, and L. J. Bergen.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 217-233, June, 1982. 4 Fig, 8 Tab, 4 Ref.

Descriptors: *Reservoir operation, *Environmental effects, *Hydroelectric plants, Reservoir releases, St. Croix River, New Brunswick, Maine, Water supply, Rivers, Water use, Shores, Erosion, International Joint Commission, Spednic Lake, Flow regulation, Water level fluctuations, Fish, Wildlife, Attitudes, Public opinion, Model studies, Georgia Pacific Corporation, Vanceboro Dam.

The St. Croix River, which straddles the international border between Maine and New Brunswick, was the scene of water use conflicts in the early 1970's. Residents and camp owners on Spednic Lake complained about adverse effects of hydropower practices on recreation, water supplies, and shorefront properties. Among the problems cited were wrecking of boats on boulders during low water, reduction in fish numbers, poor access to the lake during low water periods, serious bank erosion, debris accumulation, dry wells in summer, and unreliable flows downstream of the dam. The International Joint Commission initiated studies to determine the effects of changes in the level of Spednic Lake and the flow fluctuations immediately downstream of the lake's impoundment, Vanceboro Dam. The system is operated by the Georgia Pacific Corporation for hydroelectric power production. The study included a public attitude survey, modeling of alternative operating procedures, and an independent study by the Georgia Pacific Corporation's consultants. A new operating procedure based on a rule curve was agreed upon. This guarantees certain minimum flows and lake levels near to the desirable summer level of 378.5 ft. Provisions were made to store sufficient water to compensate for a loss of capacity in a thermal plant in the system. The new operating procedure produces more favorable summer water levels in the lake and higher streamflows for water quality and fish. No major complaints from the public of government agencies have been received since the new operating policy has been instituted. (Cassar-FRC)
W82-06429

THE LANDSCAPE OF RUTLAND WATER,
S. Crowe.
Hydrobiologia, Vol 88, No 1-2, p 43-46, March, 1982.

Descriptors: *Reservoir, *Water supply, *Land management, *Design criteria, *Planting management, Drawdown, Land use, Zoning, Land resources, Forest management, Forest watersheds, Recreation, Wilderness areas, Water sports, Rutland Water, England.

Landscape problems encountered at Rutland Water included reconciliation of the reservoir and its works with the rural surroundings, siting and treatment of all ancillary works, mitigation of exposure of shore line by drawdown, provision of opportunities for recreation without damage to the environment, and nature conservation. The means adopted to solve these problems were forward planning, consultation with all interests concerned, extensive planting of native species, and arrangemens for appropriate maintenance. The landscaping process began with an extensive survey of the character of the site. Fortunately, reservoir topography resulted in a diversified shape of acceptable scale. Special attention was paid to avoiding incongruities caused by drawdown, and long dam, the pumphouses, and the canalized stream below the dam. To minimize time and cost of maintenance, most of the perimeter land is either grazed by sheep or maintained as woodland. (Titus-FRC)
W82-06478

POWER PLANT SITING,

Ebasco Services Inc., Greensboro, NC.
N. R. Tilford.
Bulletin of the Association of Engineering Geologists, Vol 19 No 2, p 187-196, 1982. 4 Tab.

Descriptors: *Site selection, *Powerplants, *Decision making, Nuclear powerplants, Hydroelectric plants, Electric powerplants, Water use, Water requirement, Thermal pollution, Environmental effects, Pumped storage, Water pollution effects, Reservoirs, Cooling water, Land use, Flood forecasting, Aquatic life, Licenses, Dams.

Water is the main requisite involved in siting any powerplant, hydroelectric, nuclear, or fossil-fueled. The ideal hydroelectric plant is located close to consumers in a high narrow gorge immediately downstream from a large valley. The best rock formations are massive, strong, and impermeable. Pumped storage facilities should meet the same requirements as the primary reservoir, but the effects of the daily or weekly filling and draining cycle must be considered. Cooling water is important in fossil-fueled electric plants, particularly coal-fired plants. For example, a 600 MW coal-fired plant uses 20 cu ft of water per sec. This water is returned to the biosphere at temperatures 8-15 F above ambient intake temperatures, possibly causing unfavorable environmental effects. Other siting factors for a coal-fired plant are transmission distance, fuel handling facilities, and waste disposal space. A method for siting electric plants is introduced. This is based on a series of criteria: exclusion criteria, avoidance criteria, and prefeence criteria, which can be applied to any geographical area. The system is weighted to help quantify the many subjective decisions. The procedure is illustrated in an evaluation of a nuclear power plant site. Candidate sites are graded on a scale of 100 with respect to engineering cost related items, nuclear licensing considerations, and environmental considerations. Among the water-related factors in the nuclear licensing category are meteorology, relative weight, 10% of total; hydrology, 10%; and depth to groundwater (a consideration under geology and seismology), 60%. Environmental considerations include aquatic ecology, relative weight, 35%; terrestrial ecology, 15%; ocean hydrogynamics, 35% (including heat dispersion capability of a water body and recirculating potential), and fresh water use, 15%. A numerical score derived for each site allows easy ranking of possible sites. (Cassar-FRC)
W82-06555

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,
Geological Survey, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06677

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,
Southeastern Forest Experiment Station, Asheville, NC.
For primary bibliographic entry see Field 5C.
W82-06966

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
E. R. Harris.
Report, April, 1981. 39 p, 1 Fig, 18 Ref.

Descriptors: *Cloud seeding, *Snowpack, *Environmental effects, *Water yield improvement, *Colorado River Basin, Orographic precipitation, Weather modification, Water resource development, Streamflow, Runoff, Flood control.

The action proposed is to seed winter storm clouds in the Rocky Mountains of the Colorado River Basin to increase snowpack, runoff, and streamflow, thereby providing increased water yield to help meet future resource demands. Proposed alternatives include: no action: a 10-year program, with an initial 5-year phase for tests in two subbasins followed by a 5-year randomized seeding program; an 8-year program in which the initial phase is reduced to 3 years; and a 6-year program with a 2-year initial phase followed by a 4-year second phase. In each of the cloud seeding options, the initial phase involves installation of meteorological and hydrological observation and data collection networks. Seeding opportunity, climatological studies, seeding mode studies, and ground-based seeding studies would be included in the initial phase for the 10-year and 8-year options. No significant impact is expected from the initial phase. Each of the three cloud seeding options includes a second, randomized demonstration phase. An operational winter cloud seeding program could result in a 10 to 15% percipitation increase. Avalanche conditions and flood hazards will be included in suspension criteria for this project. It is expected that the use of seeding agents in this precipitation management research will have no environmental impact. A Finding of No Significant Impact for the Design Phase of the Colorado River Enhanced Snowpack Test is included. (Moore-SRC)
W82-06967

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. P. Musatov, G. F. Krasnozhon, and E. A. Fedoseev.
Water Resources, Vol 8, No 4, p 341-354, July/August, 1981. 5 Fig, 4 Tab, 33 Ref. Translated from Vodnye Resursy, No 4, p 21-37, July/August, 1981.

Descriptors: *Water management, *Fish management, *River regulations, Ecological effects, Volga Delta, North Caspian Sea, Fisheries, Deltas, Spawing, Water distribution, River flow, Salinity, Runoff, Productivity, Sturgeon, Fish passages, Canals, Aquatic habits, Reservoir releases, Estuarine environment, Estuaries, *USSR, Environmental effects, Flow control, Water resources development.

The North Caspian Sea and the Volga, Ural, and Terek basins should be considered as a single biome for the purposes of water management, according to a review of published data. Factors affecting fish reproduction and growth and allowing water regimes to achieve optimum development of fisheries are discussed. In the Volga delta the regulation of river runoff has changed the location and character of the fish spawning grounds, has caused the dates of the maximum and the end of the flood cycle to occur significantly earlier, has lowered the temperature of runoff, and has significantly decreased the abundance of fish caught in the region. In the North Caspian Sea salinity regimes are affected by river regulation. Productivity of the deep zones increases during wet years, and productivity in the shallow zone increases during dry years. Proper operation of the water distributor at the apex of the Volga delta is suggested for regulating the ecosystems in this region. This would increase freshening of the North Caspian waters and preserve the habitat for the brackish water complex of fish. Although operating the distributor disturbs the sturgeon migration, the author feels that these problems can be solved by fish passages, large scale transportation of spawners upstream, and changing the balance of releases between eastern and western parts of the Caspian. River regulation has also changed the physical nature of the Volga delta and lowered the level of the Caspian Sea. The number of distributary channels has doubled since 1912, reducing current velocity, increasing siltation and shoaling, salinizing the estuarine nearshore zone, and destroying connections between the sea and some fishways. Specific suggestions for improving the flow to the eastern fishways of the Volga are given. These include construction of additional canals. (Cassar-FRC)
W82-06985

7. RESOURCES DATA

7A. Network Design

LEAK LOCATION ENTERS COMPUTER AGE,
New York City Dept. of Environmental Protection, Bureau of Water Supply.
D. S. Greeley.
American City and County, Vol 97, No 5, p 14, 17, 18, May, 1982. 3 Fig.

Descriptors: *Water conservation, *Leakage, Water loss, *New York City, Measuring instruments, Water distribution.

With drought conditions facing New York, the city turned to the use of a computerized leak detection patrol to stop wastage of valuable water. After it had been in use for one year, the method had located some 43 mgd in leaks. When the first mobile leak detection van arrived in December of 1980 the manufacturer provided an intensive classroom training session to familiarize the laborers with the New York City water supply system, fundamentals of leak detection, and the principle behind the leak location system. The equipment provided so useful that three more leak detection vans were purchased in June of 1981 as the drought conditions intensified. The leak detection unit is about the size of a portable radio and allows a surveyor to listen to live valves, hydrant valves, and service lines along a water main. When a leak noise is picked up, the surveyor brackets the leak by identifying the points of maximum noise on the main. He then marks the distribution system map and continues surveying. The maps of each surveyor are referred to a follow-up crew in a leak detection van which wires the transducer connections into the console inside the van. By use of a microprocessor and oscilloscope and knowing the diameter of the water main the operator in the van can pinpoint the precise location of the leak. The savings of 43 mgd represented more than 500 leaks. (Baker-FRC)
W82-06018

WATER-QUALITY ASSESSMENT OF CACHE CREEK, YOLO, LAKE, AND COLUSA COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. K. Sorenson, and A. L. Elliott.
Geological Survey Open-File Report 81-677 (WRI), July 1981. 41 p, 14 Fig, 1 Plate, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Water quality standards, *Data collections, *Water supply, Water use, Surface water, Streamflow, Suspended sediments, Sampling, Monitoring, Sites, Dissolved oxygen, Pesticides, Potential water supply, *California, Cache Creek, Clear Lake, Yolo Bypass.

Cache Creek and its tributaries from Clear Lake to Yolo Bypass have been the subject of quality and quantity of water studies by several governmental agencies since the early 1900's. Water-quality data from these studies showed that water in the basin is of good quality for most of the beneficial uses defined by the California State Water Resources Control Board. Concentrations of dissolved constituents are substantially higher in the water in the two largest tributaries than in Cache Creek. Seasonal variations in dissolved constituents are also greater in the tributaries than in Cache Creek. Clear Lake has a major effect on water quality, resulting in little seasonal fluctuation in water quality in Cache Creek. Excessive voron and suspended-sediment concentrations are the greatest water-quality problems, according to existing data. Both of these problems are from natural sources. Water-quality monitoring is presently being conducted monthly at four sites by the California Department of Water Resources and at several other sites by other agencies. Modifications in current monitoring are proposed to gain further information on diel dissolved-oxygen cycles, pesticides, and bio-

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logical constituents that may adversely affect beneficial uses. (USGS)
W82-06130

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,
CH2M/Hill, Atlanta, GA.
For primary bibliographic entry see Field 5A.
W82-06235

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,
Missouri Univ., Kansas City. Dept. of Geosciences.
For primary bibliographic entry see Field 6A.
W82-06552

THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,
Department of the Environment, Reading (England). Water Data Unit,
For primary bibliographic entry see Field 7C.
W82-06591

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Robison, L. S. Forcella, and M. W. Gannett.
Open-File Report 81-1002, 1981. 24 p, 3 Fig, 1 Tab.

Descriptors: *Data collections, *Geothermal studies, *Test wells, *Drillers logs, Temperature, *Oregon, Mount Hood.

This report includes well specifications, drillers' logs, and temperature logs of geothermal test wells drilled at 7 sites near Mt. Hood, Oreg. The wells were drilled in 1979 and 1980 under contract to the U.S. Geological Survey. The project, funded by the U.S. Department of Energy, was part of an interagency effort to determine the geothermal potential of Mt. Hood. The agencies involved were, U.S. Department of Energy, U.S. Forest Service, U.S. Geological Survey, and Oregon Department of Geology and Mineral Industries. (USGS)
W82-06950

7B. Data Acquisition

LIQUID LEVEL INTERFEROMETER,
Arizona Univ., Tucson. Optical Sciences Center.
S. F. Jacobs, and J. G. Small.
Applied Optics, Vol 20, No 20, p 3508-3513, October, 1981. 10 Fig, 6 Ref. OWRT A-091-ARIZ(2).

Descriptors: *Interferometry, *Water level recorders, *Water level fluctuations, *Evaporation rate, *Measuring instruments, Lasers, Water level, Water loss, Reservoirs, Design criteria, Sensors, Reservoir evaporation, Field tests, On-site tests, Ponds.

An inexpensive field instrument was designed and constructed to measure changes in water levels, appropriate to ponds and reservoirs, to an accuracy of lambda/8. A novel magnetic suspension is used to position the floating retroreflector of the laser interferometer. Direction-sensing is achieved by dual optical channels phased near quadrature by means of an absorbing beam-splitter. Field measurements were made for an open pond having a surface area of about 600 sq. m. A typical recording of evaporation over a 36-hour period is shown, including the detection of a brief period of precipitation. Using an electric fan blowing across 0.1 sq. m of water in a laboratory test, an evaporation rate in the order of one micron/minute was measured. By measuring the slopes of a 4-day recording, a record of evaporation rate was determined as a function of time of day: in addition to the expected midday peak, reproducible peaks (possibly due to morning and evening winds) were observed in the morning and evening. The laser was an inexpensive He-Ne laser which produces multiple longitudinal modes which reduce fringe contrast for large unequal paths of the interferometers arms. The instrument achieves 0.08 micron sensitivity despite moderate water turbulence, possesses directional sensing, and includes a measurement of its own temperature for thermal expansion correction. (Zielinski-MAXIMA)
W82-05929

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
J. L. Heilman, and D. G. Moore.
Remote Sensing of Environment, Vol 12, No 2, p 117-121, 1982. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Remote sensing, *Soil water, *Soil temperature, Satellite technology, Heat Capacity Mapping Mission, Mapping, Vegetation effects, Soil types, Land use.

Heat Capacity Mapping Mission (HCMM) data were analyzed to determine their suitability for estimating near-surface soil moisture in a complex agricultural landscape with several soil types and crop types. The area monitored was a 8 x 24 km section of the Big Sioux River Basin, South Dakota. The HCMM radiometric temperatures did not correlate with soil water content for the four dates analyzed (June 5, July 13, August 8, and September 4, 1978). There was a mixture of land uses and soil covers within each pixel. However, when soil surface temperatures were empirically estimated from HCMM temperatures and percentage cover of each pixel, a highly significant correlation was obtained between estimated soil temperature and near surface soil water content. (Cassar-FRC)
W82-05956

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W82-06212

TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W82-06214

PORTABLE WATER ELEVATION MEASURING GAGE,
Bureau of Reclamation, Denver, CO., Engineering and Research Center.
M. Gutierrez.
Report GR-81-14, September 1981. 31 p, 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Monitoring, *Groundwater level, *Water measurement, *Groundwater availability, *Well discharge, Salinity, Water level, Well casings, Recharge, Permeability.

One of the initial activities usually undertaken in ground-water investigations is an inventory of existing ground water availability and collection of water in wells. A portable system was developed for continuously monitoring the water elevation in wells by measuring the capacitance of an insulated wire placed in the water. The gage provides continuous readout, fast response to water elevation changes, and insensitivity to internal pressures. There is no effect on readings because of cascading water action. The gage can be initialized to read zero at various water elevations, and readings are not affected by water salinity. Results from a limited amount of testing indicate the feasibility of the measuring gage. The well under test had flaws in the well casing, and these irregularities of the well casing are shown in the test results. The detection of these irregularities led to speculation on other possible applications for the measuring gage in soil permeability testing and in detection of fractures in concrete and rock. Three methods for groundwater measurement are possible using this instrument: measurement of well discharge by water withdrawal or by disperson using air pressure in the well casing; measurement of the recharge rate after withdrawal of water; and measurement of the water elevation of normal conditions. (Moore-SRC)
W82-06396

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,
Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
G. Drufuca, and G. Macchiarella.
Atmosphere-Ocean, Vol 20, No 1, p 69-75, 1982. 4 Fig, 12 Ref.

Descriptors: *Remote sensing, *Rainfall rate, *Rainfall intensity, Precipitation intensity, Spina d'Adda, Italy, Radar, *SIRIO-SHF experiment, Model studies, Rain attenuation, Storms.

A model of rain attenuation, a bidimensional version of the snythetic storm technique, was developed and successfully tested by comparing the attenuation probability distribution from a year of measurements at 11.6 GHz and 32 degree elevation angle at the Spino d-Adda, Italy, receiving station with the rainfall rates measured at that station. Two different vertical rain profiles (rectangular and trapezoidal) reproduced the attenuation statistics, but each showed a different dependence on elevation angle, depicted on a graph for elevation angles from 5 to 45 degrees. Both models predicted lower attenuation than did the cosecant law for small elevation angles and higher attenuation for elevations above 30 degrees, particularly for the trapezoid model. (Cassar-FRC)
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. Atlas, J. Eckerman, R. Meneghini, and R. K. Moore.
Atmosphere-Ocean, Vol 20, No 1, p 50-61, 1982. 2 Fig, 21 Ref.

Descriptors: *Remote sensing, *Rainfall, *Measuring instruments, Radar, Precipitation, Storms, Microwaves, Infrared imagery, Meteorology, Radiometry, Sampling.

The visible/infrared techniques, microwave radiometry, and radar can help in obtaining useful precipitation measurements from space. No single instrument or method currently satisfies the two requirements: adequate spatial and temporal sampling of the storm and sufficient accuracy in precipitation intensity estimates. The visible/infrared instruments provide good temporal sampling and rain area depiction. Microwave obtains quantitative rainfall estimates. Radar can overcome the inadequacies of microwave radiometric measurements over land. The accuracy, dynamic size, and system implementation of several radar methods are discussed: modified altimeter (simplest, least costly, but restricted to nadir measurements), short wavelength scanning radar (can scan cross-track to provide a swath measurement), surface target attenuation radar or STAR (variations include the surface comparison and the frequency agility methods), and the adaptive pointing beam. A hybrid approach that combines the surface reference technique (STAR), the frequency agility system, the short wavelength reflecting schemes, the adaptive pointing approach, and microwave radiometry may be a starting point in development of a suitable system. (Cassar-FRC)
W82-06531

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,

Wyoming Univ., Laramie. Water Resources Research Inst.
D. L. Wichers, T. A. Wesche, L. S. Johnson, and J. A. Gore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256777, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Series Report No 83, May 1982. 48 p, 7 Fig, 2 Tab, 25 Ref. OWRT B-038-WYO(3), 14-34-0001-8130.

Descriptors: *Trout, *Aquatic habitats, *Fish migration, *Telemetry, Radiometry, Radioisotopes, Radioactivity, Radioactivity techniques, Antimony, Microenvironment, Wildlife habitats, Environment, Fish behavior, Fish populations, Remote sensing, Sensors, Ice cover.

Two techniques were devised and evaluated for locating and sampling instream brown trout microhabitat under complete ice cover conditions. Radiotelemetry (RT) using surgically-implanted transmitters (SIT) was superior to implantation of radioisotope (antimony-124) capsules for tracking under-ice movements and locating microhabitat locations. The wax-acrylic coated transmitters (15-20g) were about 2.2 inches long, and had a lifespan estimated at 6 months. Fish could be located/tracked by a receiver by walking on the ice or by flying at 500-1000 feet above the ice. The advantages of the RT method were that the use of SIT does not present a potentially hazardous situation, that locating implanted fish by RT is unimpaired by severe weather, and that signals could be sensed up to 200 m and were unaffected by water depth, ice, snow, dense undercut banks, and temperature. The major problem with SIT was battery failure. Measurements of trout movements under ice cover indicated that freezing water temperatures significantly decreased trout activity. Trout preferred to remain within focal areas as resting microhabitats, with their activity decreasing as winter conditions progress. The microhabitat preference data developed should assist recommendations of suitable winter instream flows for medium-sized trout streams which develop total ice cover during winter. (Zielinski-MAXIMA)
W82-06703

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 2D.
W82-06780

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),
Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
For primary bibliographic entry see Field 2B.
W82-06823

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),
Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
For primary bibliographic entry see Field 2D.
W82-06824

COMPARISON OF AUTOMATED SATELLITE SYSTEMS WITH CONVENTIONAL SYSTEMS FOR HYDROLOGIC DATA COLLECTION IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. M. Woodham.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $3.50 Microfiche $3.50. Open-File Report 81-1180, 1982. 23 p, 3 Fig, 5 Tab, 1 Ref.

Descriptors: *Hydrologic data collections, *Telemetry, *Remote sensing, *Data transmission, Monitoring, Sites, Satellite technology, Comparison studies, Cost analysis. *Florida, West-central Florida, GOES, Southwest Florida Water Management District.

This report provides results of reliability and cost-effective studies of the goes satellite data-collection system used to operate a small hydrologic data network in west-central Florida. The GOES system, in its present state of development, was found to be about as reliable as conventional methods of data collection. Benefits of using the GOES system include some cost and manpower reduction, improved data accuracy, near real-time data availability, and direct computer storage and analysis of data. The GOES system could allow annual manpower reductions of 19 to 23 percent with reduction in cost for some and increase in cost for other single-parameter sites, such as streamflow, rainfall, and ground-water monitoring stations. Manpower reductions of 46 percent or more appear possible for multiple-parameter sites. Implementation of expected improvements in instrumentation and data handling procedures should further reduce costs. (USGS)
W82-06951

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, P. E. O'Neill, G. C. Coleman, and T. J. Schmugge.
Agricltural Research Results ARR-NE-14, July, 1982. 18 p, 4 Fig, 6 Tab, 2 Ref.

Descriptors: *Remote sensing, *Soil water, *Hydrologic data, *Aerial photography, *Infrared imagery, Agricultural hydrology, Soil temperature, *Oklahoma.

The study sites in Oklahoma were in the Washita River Experimental Watershed, Chickasha area. Data flights were made and ground samples collected on June 24, August 14, and September 9, 1980. Soil moisture samples were collected using a gravimetric technique for depth intervals of 0-2.5, and 5-15 cm. Soil temperature samples were obtained at depths of 2.5 and 15 cm. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, L and C band radiometer, a passive microwave scanner, and four active microwave sensors (K, C, L, and P band scatterometers). Generally the soil moisture conditions were relatively wet on the date of the first flight and very dry on the last two flights. These results were ideal because the wet condition data provided verification of the sensor performance in 1978 and the dry condition data allowed the extension of the 1978 data set. The report includes soil moisture measurements, climatic observations, and the remote sensing data collected in order to evaluate aircraft remote sensing techniques. (Moore-SRC)
W82-06969

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,
Kansas State Univ. Manhattan. Dept. of Geography.
M. D. Nellis.
Remote Sensing of Environment, Vol 12, No 3, p 229-234, 1982. 4 Fig, 4 Ref.

Descriptors: *Canal seepage, *Leakage, *Remote sensing, Infrared imagery, Conveyance structures, Water conveyance, Seepage, Aircraft, *Oregon, North Unit Irrigation District, Soil water, Irrigation canals, Water loss.

Canal leakage sites were detected by a HRB Singer AN/AAS 14 optical-electronic thermal infrared scanning system, sensing in the 8-14 micron range. The apparatus was flown in an aircraft on May 21, 1979, at 2100 hours and 900 m altitude over the main North Unit Canal in central Oregon. Moist sites emitted more radiation during the evening hours and less during peak solar radiation hours than the low moisture, or nonleaking sites. Out of 39 sites showing the characteristics of leakage sites, 12 were verified as actual leakage sites by field analyses. Inspection of the canal uncovered no leakage sites not appearing on the imagery. The sites misinterpreted as leakage sites featured dense natural vegetation, farm canals, drainage ditches, small holding ponds, or natural depressed drainage areas. This interference could be reduced by taking simultaneous color photographs. This economical and practical leakage detection method could help save some of the 58,800 acre feet (or 1 acre-ft per acre of irrigated land) 0.6-7.3 m, and lengths were 12.2.-91.4 m. 75% were oblong in shape, and the remainder were irregular. (Cassar-FRC)
W82-06994

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,
Meteorological Satellite Center, Tokyo (Japan).
T. Aoki, and T. Inoue.
Remote Sensing of Environment, Vol 12, No 3, p 219-228, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Precipitable water, *Infrared imagery, *Pacific Ocean, *Geostationary Meteorological Satellite, Seasonal variation, Meteorology, Water vapor,Marine climates, Air temperature, Water temperature, Temperature, Satellite technology, Tropical regions.

Total precipitable water over the tropical oceans was determined from infrared radiometer data in the atmospheric window region using data from the Geostationary Meteorological Satellite of Japan. The information about sea surface temperature, atmospheric temperature, and atmospheric water vapor involved in the observed radiation in the atmospheric window region varied greatly with the amount of water vapor in the atmosphere and thus with the latitude. At low latitudes the atmospheric window region contained much information about water vapor and mean temperature of the lower atmosphere but very little information about the sea surface teperature. Satellite derived values agreed well with radiosonde data, within 0.53 g per sq cm rms difference. The weekly man distribution of precipitable water over the tropical section of the western Pacific Ocean was obtained for summer and winter. July 1-7, 1979, values varied from 5.0 g per sq cm north of New Guinea at latitudes 10 degrees south to 10 degrees north to 4.0 g per sq cm further from the equator. January 1-7, 1979, values showed a shift of the maximum precipitable water, 3.0 g per sq cm, to the south. Results agreed reasonably with data from other authors and measured climatological data. (Cassar-FRC)
W82-06995

7C. Evaluation, Processing and Publication

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
For primary bibliographic entry see Field 2G.
W82-05928

HYDROGEOLOGIC DATA FROM TWO WELLS AT MYAKKA HEAD, MANATEE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $3.50, Microfiche $3.50. Geological Survey Open-File Report 81-1070, 1982. 21 p, 15 Fig.

Descriptors: *On-site data collections, *Observation wells, *Well data, *Water quality, Geohydrology, Water level, Chlorides, Well logs, Hydro-

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graphs, *Florida, Manatee County, Myakka Head, Southwest Florida Water Management.

Well construction data, lithologic and geophysical logs, and water-quality data are presented for a deep (1,210 feet) well drilled at myakka Head, Manatee County, Florida. A shallow well (600 feet) was drilled at the same site. The wells were drilled as part of the Southwest Florida Water Management District's Regional Observation and Monitor-Well Program. The deep well is cased to a depth of 909 feet and open from 909 to 1,210 feet. The shallow well is cased to a depth of 563 feet and open from 563 to 600 feet. Chloride concentration of water from the deep well is 17 milligrams per liter. (USGS)
W82-06129

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,
Geological Survey, Syosset, NY. Water Resources Div.
R. K. Krulikas.
Geological Survey Open-File Report 81-500 (WRI), 1981. 27 p, 2 Fig, 1 Plate, 2 Tab, 11 Ref.

Descriptors: *Areal hydrogeology, *Data collections, *Aquifer systems, *Groundwater, *Wells, Test holes, Geohydrologic units, Geology, Well data, Urbanization, Water use, Water supply, Available water, *New York, *Long Island, Suffolk County.

The population of Suffolk County, New York, an area of 922 square miles, has increased rapidly, from less than 200,000 in 1940 to about 1.3 million in 1978. Ground-water pumpage has increased from an average of 42 million gallons per day in 1950 to about 257 million gallons per day in 1978. To help supply the hydrologic information needed to anticipate and prevent shortages, this report presents hydrogeologic and well-completion data on over 700 wells and test holes. (USGS)
W82-06131

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,
Geological Survey, Bismarck, ND. Water Resources Div.
N. D. Haffield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-xxxxxx, Price codes: Axx in paper copy, A01 in microfiche.
Geological Survey Open-File Report 81-1066, July 1981. 78 p, 1 Fig, 11 Ref.

Descriptors: *Hydrologic data, *Water quality, *Surface water, Streams, Sediment, Gaging stations, Sites, Sampling, Water analysis, *North Dakota.

Statistics for the streamflow and water-quality data collected at 67 stations in western North Dakota from October 1977 through September 1980 are presented in a format that will make the data more useful to those who are making water-resources planning and development decisions. (USGS)
W82-06133

GROUND-WATER DATA FOR THE BERYL-ENTERPRISE AREA, ESCALANTE DESERT, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Mower.
Geological Survey Open-File Report 81-340, 1981. 64 p, 1 Fig, 1 Plate, 6 Tab.

Descriptors: *Data collections, *Groundwater, *Wells, *Water level, *Water quality, Chemical analysis, Water yield, Observation wells, Drillers logs, Well data, *Utah, Escalante Desert, Beryl-Enterprise area.

This report contains a compilation of selected ground-water data for the Beryl-Enterprise area, Iron and Washington Counties, Utah. The records of the wells include such information as driller's logs, yield, drawdown, use, and temperature of the well water. There are also records of water levels in selected wells for the period 1973-79, chemical analyses of ground water, records of selected springs, and a tabulation of ground-water withdrawals for 1937-78. (USGS)
W82-06134

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1051 (WRI), 1980. 1 Sheet, 25 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Groundwater, Natural recharge, Water level, Observation wells, Water level fluctuations, Geohydrology, Hydrographs, *Mississippi, Sparta aquifer system, Sparta Sand.

This potentiometric map of the Sparta aquifer system is the tenth in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Sparta, the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer into streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson, Yazoo City, Cleveland, Clarksdale, and Memphis areas. Historically, water levels in or near the outcrop of the Sparta have shown little or no long-term changes, but during the past 20 years, in much of the confined part of the aquifer, water levels have declined from 1 to 3 feet per year. (USGS)
W82-06135

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWER-PLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-06137

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Geological Survey Open-File Report 81-1123 (WRI), 1981. 1 Sheet, 8 Ref.

Descriptors: *Maps, *Water level, *Groundwater, *Alluvial aquifer, Aquifer characteristics, Deltas, Wells, Precipitation, Water level fluctuations, Pumping, Irrigation, Geohydrology, Hydrographs, *Mississippi, Mississippi River valley alluvial aquifer.

Water levels were measured in 454 wells in the alluvial sediments in northwestern Mississippi during the period April 13-24, 1981. Ground-water levels are higher after winter and spring rains and lower after heavy agricultural and industrial pumping. Locally, water levels fluctuate as rivers and streams fluctuate. Because of the drought conditions in April 1981, most water wells had risen several feet. In some areas, however, water levels had not recovered from the relatively low levels measured in September 1980. (USGS)
W82-06138

SELECTED BIOLOGICAL CHARACTERISTICS OF STREAMS IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Naten, and R. H. Fuller.
Geological Survey Open-File Report 81-644 (WRI), 1981. 38 p, 26 Fig, 4 Tab, 12 Ref.

Descriptors: *Data collections, *Biological samples, *Water quality, Oil shale, Environmental effects, Bacteria, Benthic fauna, Ecological distribution, *Utah, *Colorado, Uinta Basin.

Biological sampling was carried out during 1976-78 in five streams in the southeastern Uinta Basin, Utah and Colorado, in order to provide baseline water-quality data for an area of potential oil-shale development. The biological activity in the streams sampled generally is limited by physical factors more so than by chemical constituents and plant nutrients. Characteristics of streamflow, such as high turbidity, fluctuating water levels, and moderate to high salinity, limit production of flora and fauna biomass. Samples were collected for the determination of bacterial and periphyton concentrations and benthic-invertebrate communities. Bacterial concentrations were generally small, with some fecal contamination, primarily from livestock and wildlife. Members of the order Chlorophyta (green algae) were the major periphytic algae present in three of the streams sampled. Bitter Creek was dominated by members of the order Cyanophyta (blue-green algae), and pennate diatoms were the predominant algae in Willow Creek. The benthic-invertebrate communities generally reflect a nonpolluted environment. Shannon-Weiner diversity indices ranged from 1.14 to 3.08. (USGS)
W82-06140

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06142

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190364, Price codes: A22 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report OR-80-2, December 1981. 491 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Western Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-state partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06143

SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202045, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CO-80-3, 1981. 452 p, 4 Fig, 5 Tab, 42 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Dolores River basin, Green River basins, San Juan River basin.

Water-resources data for Colorado for the 1980 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage patial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W82-06144

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
O. Mintzer, and F. Askari.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243668, Price codes: A04 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, Report No 712508, October 1980. 53 p, 14 Fig, 13 Tab, 32 Ref, 7 Append. OWRT A-063-OHIO-(1).

Descriptors: *Remote sensing, *Mathematical models, *Regression analysis, *Spectral analysis, *Runoff coefficients, Aerial photography, Satellite technology, Sensors, Telemetry, Infrared imagery, Watershed management, Runoff, Mathematical studies, Data interpretation, Experimental data, Watersheds, Model studies, *Ohio, Mill Creek.

Research was carried out to derive runoff coefficients for watersheds of Mill Creek in Coshocton County, Ohio, from LANDSAT multispectral data by including the more detailed (level II) surface conditions and soil types along with land cover (level I) types in the analysis techniques. Regression models were developed from treating the runoff coefficient of each sample site as the dependent variable, and the mean radiance measurements in the four LANDSAT channels as the independent variables. The models were then extended over the area, and the classification results consisted of digital color-coded maps illustrating spatial variability of runoff potential for the surface. The computer-derived patterns were confirmed with known features within the area, and individual test fields and watersheds were selected for verification of the model results. The model-derived runoff coefficients compared favorably with those obtained from ground truth. It was concluded that, for the sampled sites of the given land cover conditions and soil type, the multispectral data analysis technique described provided reasonable values of runoff coefficients for the watersheds tested. (Zielinski-MAXIMA)
W82-06151

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
C. H. Whitlock, C. Y. Kue, and S. R. LeCroy.
Remote Sensing of Environment, Vol 12, No 2, p 151-168, 1982. 6 Fig. 5 Tab, 19 Ref.

Descriptors: *Remote sensing, *Regression analysis, *Pollutant identification, Radiance, Network design, Satellite technology, Errors, *Sediments. The limitations, requirements, and precision of linear multiple regression techniques for quantifying marine environmental parameters such as sediments and pollutants were evaluated. Radiance was the independent variable. Both environmental and optical physics conditions were defined for which an exact solution to the signal response equation is of the same form as the multiple regression equation. One problem with using this regression technique is that the independent variables. (Upwelled radiaces) contained errors which were often correlated with each other. This situation required a large number of statistical parameters when performing the regression analysis. Examination of field experiments showed that the magnitude of the data noise required data smoothing before Daniel and Wood's criteria could be satisfied for the least-square multiple regression process. To minimize data smoothing requirements and associated physical errors, ground truth locations whould be carefully chosen. Specific suggestions for environmental and ground truth conditions are given. (Cassar-FRC)
W82-06233

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,
Technicon Instruments Co. Ltd. (England).
For primary bibliographic entry see Field 5F.
W82-06259

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 4A.
W82-06300

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. R. Chirlin, and E. F. Wood.
Water Resources Research, Vol 18, No 2, p 432-438, April, 1982. 1 Fig, 17 Ref.

Descriptors: *Spatial distribution, *Estimating equations, *Statistical analysis, Model studies, *Probability distributions, Stationary process, Hydrologic data, Mathematical studies, *Kriging, *State estimation.

Universal kriging is one method of interpolating sampled random spatial processes which has applications in hydrology. The interpolation task is complicated by process noise and data measurement error. Kriging is a technique which refers to a family of stochastic process models plus associated parameter estimation procedures. It is based on a theory of 'differencing' of n-dimensional spatial processes and is well developed for the delineation of mineral deposits. Universal kriging interpolates a discrete stationary spatial process obtained by polynomial filtering through spatial differencing of the original nonstationary process. In this paper, the universal kriging axioms, calculation of some statistics of the kriging system variables, definition and solution of the state space version of the kriging problem, and an example are presented. (Titus-FRC)
W82-06323

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. R. Philipson, K. Kozai, and E. L. Mills.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256637, Price codes: A03 in paper copy, A01 in microfiche. Report, December, 1981. 29 p, 8 Fig, 4 Tab, 49 Ref, 1 Append. OWRT A-091-NY(1). 14-34-0001-1134.

Descriptors: *Water quality, *Eutrophic lakes, *Remote sensing, *Satellite technology, *Regression analysis, Evaluation, Sensors, Telemetry, Mathematical models, Computer models, Mathematical studies, Model studies, Water quality control, Lakes, Chlorophyll A, Density stratification, Air temperature, Wind, Lake breezes.

A methodology development was undertaken for use in selecting optimum sampling locations for water quality assessment in a large eutrophic New York State lake (Oneida Lake). The methodology approach was based on the premises that Landsat satellite image densities can be modeled, and that homogeneous water quality areas could be thereby predicted. Patterns of Lake density on 24 Landsat band-5 images (0.6-0.7 microns) were traced from a density-slicer screen, following standardization of the color assignments with dark- and a light-toned feature. The Lake was griddled into 161 cells (1.25 km by 1.25 km each), and density levels from each image were encoded for each cell. Cell density levels were used as the dependent variable in correlations and multiple regressions with degree days, and resultant wind speed and direction. Further, equation-predicted density levels in selected cells were correlated with measured values of chlorophyll-A, chlorophyll-a plus pheophytin, and Secchi disk transparency. It was found that the use of degree days and wind in evaluating water quality represents a promising and improved approach. While reliability of the regression equations was too low to develop an effective lake sampling strategy, results suggest further study appears justified. (Zielinski-MAXIMA)
W82-06370

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,
Natal Univ., Pietermaritzburg (South Africa).
For primary bibliographic entry see Field 2E.
W82-06386

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W82-06529

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),
Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131-S, Background Data Supplement, 1981. 121 p, Tab.

Descriptors: *Canada, *Eutrophication, Nutrient reduction, Phosphorus, Nitrogen, Chlorophyll, Hypolimetic oxygen rate, Loadings, Data, Lakes, Basins, Graphs, *Data collections, *Pollutant identification.

This background data supplement contains information sheets listing the most pertinent background information for the lakes and basins discussed in the main report; The OECD Cooperative Programme on Eutrophication Canadian Contribution, (Scientific Series No. 131). (WATDOC)
W82-06567

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,
Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
For primary bibliographic entry see Field 2E.
W82-06568

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06586

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THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,
Department of the Environment, Reading (England). Water Data Unit,
R. V. Moore, and D. W. C. Rodda.
Water Science and Technology, Vol 13, No 11/12, p 707-714, 1981. 2 Fig, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Data storage and retrieval, Computers, Data management, Data collections, *United Kingdom, Water quality data, Hydrologic data collections.

Ten regional authorities in England and Wales have responsibility for all aspects of the water cycle, including monitoring of water quality. These authorities collect data for their own water management needs, for assessing the effectiveness of water pollution legislation, and for determining the rate of improvement or deterioration of water resources. The need for similar types of information and for information which can be compared among the regions has led to the development of the Water Archive System, which provides a cost-effective solution to the organization and control of data for the authorities. The Water Archive System manages water quality data; hydrological, biological, and meteorological data; and data on water supply and wastewater disposal. The objectives and applications of this national computer-based system are described. The computer system is simple in concept and use, but capable of handling a wide range of data. A high level of user participation in project management has been encouraged in order to promote commitment to the project. A System for achieving national agreement with respect to data definitions has helped to promote data comparability. The Water Archive System is currently used by seven of the regional water authorities, as well as by the British Department of the Environment and by the Ministry of Agriculture, Fisheries, and Food. (Carroll-FRC)
W82-06591

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,
For primary bibliographic entry see Field 2A.
W82-06613

WATER RESOURCES DATA FOR TENNESSEE, WATER YEAR 1980.
Geological Survey, Nashville, TN. Water Resources Div.
Geological Survey Water-Date Report TN-80-1, 1981. 513 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water levels, Data collections, Sites, *Tennessee.

Water resources data for the 1980 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 108 gaging stations, stage only records for one lake gaging station, elevation and contents for 27 lakes and reservoirs, water quality for 82 stations and 21 wells, and water levels for 26 observation wells. Also included are 127 crest-stage partial-record stations, 73 low-flow partial-record stations, and 80 coal-hydrology partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (USGS)
W82-06670

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. P. Thomas, and A. Dunne.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $31.50, Microfiche $3.50. Geological Survey Open-File Report 81-1071, August 1981. 230 p, 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Floods, *Basins, *Streamflow, *Flood data, Surface water, Flood peak, Flow characteristics, Flood frequency, Flood recurrence interval, Gaging stations, Monitoring, *New Mexico, Log Pearson type III analysis.

Selected basin characteristics, flood characteristics, flood statistics and peak flows are summarized for 277 unregulated basins in New Mexico and adjacent areas of conterminous States. Station descriptions are included in the peak flow listing; a State map shows areal location. (USGS)
W82-06671

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,
Geological Survey, Austin, TX. Water Resources Div.
R. Perez.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $11.75, Microfiche $3.50. Geological Survey Open-File Report 81-922, August, 1981. 91 p, 1 Fig, 5 Tab, 5 Ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, *Storm runoff, *Urban runoff, *Hydrologic data, Small watersheds, Streamflow, Flow rates, Flood peak, Flood profiles, Watershed Management, *Texas, San Antonio.

This report contains rainfall, runoff, and water-quality data collected during the 1978 water year for the San Antonio metropolitan area. The information will be useful in determining the effects of various stages of ubanization on flood discharge and runoff and in determining chemical constituents in surface-water runoff from floods of various magnitudes during all seasons of the year from areas with different types of urban development. Detailed rainfall-runoff computations are presented for several storm periods during the 1978 water years. (USGS)
W82-06672

WATER-RESOURCES INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN ARKANSAS--FISCAL YEAR 1981.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $6.50, Microfiche $3.50. Geological Survey Open-File Report 81-1003, 1981. 44 p, 20 Fig. (Gurley, M. O., Compiler).

Descriptors: *Data collections, *Groundwater, *Water quality, *Surface water, Gaging stations, Sites, Streamflow, Flow characteristics, Sediments, Dye releases, Sampling, Water level, Wells, Water use, *Arkansas.

During fiscal year 1981 there were 20 water-resources investigations in progress by the Arkansas District of the U. S. Geological Survey's Water Resources Division. Investigations that mainly involved data collection included surface-water gaging, water-level measuring, water-quality sampling, sediment sampling, and water-use inventorying. Interpretive studies included three that were principally of ground-water resources, four that were of surface-water flow charateristics, four that were of surface-water quality characteristics, and three that were interdisciplinary. (USGS)
W82-06673

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1981--VOLUME 1. CENTRAL AND NORTHERN LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Geological Survey Water-Date Report LA-81-1, 1981. 424 p, 10 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, Central and Northern Louisiana.

Water resources data for the 1981 water year for Lousiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage of 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data system operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-06674

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1053 (WRI), 1981. 1 Sheet, 22 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Goundwater, Natural recharge, Water level, Observation wells, Water level fluctutations, Geohydrology, Hydrographs, *Mississippi, Cockfield formation, Cockfield aquifer.

This potentiometric map of the Cockfield aquifer is the eleventh in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Cockfield quifer the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer by streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson and Greenville areas. Historically, water levels in or near the outcrop of the Cockfield aquifer have shown little or no long-term changes, but in much of the confined part of the aquifer during the past 20 years, water levels have declined from 1 to 2 feet per year. (USGS)
W82-06676

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-06681

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,
Geological Survey, Tallahassee, FL.. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
J. A. Leenheer, and J. C. Bagby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195280, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 82-15, March 1982. 39 p, 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Organic compounds, *Groundwater, *Water quality, *Path of pollutants, Observation wells, Monitoring, Sampling, Pesticides, Radioactive waste disposal, Aquifers, Groundwater movement, Geochemistry, *Idaho, Snake River Plain aquifer, Idaho National Engineering Laboratory.

In August 1980, the U.S. Geological Survey started a reconnaissance survey of organic solutes in drinking water sources, ground-water monitoring wells, perched water table monitoring wells, and in select waste streams at the Idaho National Engineering Laboratory. The survey was to be a two-phase program. In the first phase, 77 wells and 4 potential point sources were sampled for dissolved organic carbon (DOC). Four wells and several potential point sources of insecticides and herbicides were sampled for insecticides and herbicides. Fourteen wells and four potential organic sources were sampled for volatile and semivolatile organic compounds. The results of the DOC analyses indicate no high level organic contamination of ground water. The only detectable insecticide or herbicide was a DDT concentration of 10 parts per trillion (0.01 microgram per liter) in one observation well. The volatile and semivolatile analyses do not indicate the presence of hazardous organic contaminants in significant amounts (>10 micrograms per liter) in the samples taken. Due to the lack of any significant organic ground-water contamination in this reconnaissance survey, the second phase of the study, which was to follow up the first phase by additional sampling of any contaminated wells, was cancelled. (USGS)
W82-06688

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W82-06690

HYDROGEOTHERMAL MAPPING OF THE ACTIVE WATER-EXCHANGE ZONE IN THE USSR,
All Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. M. Frolov.
Water Resources, Vol 8, No 3, p 319-328, May/June, 1981. 2 Fig, 3 Tab, 11 Ref. Translated from Vodnye Resursy, No 3, p 154-166, May/June, 1981.

Descriptors: *Maps, *Geohydrology, *Heat flow, Groundwater, *USSR, Temperature gradient, Geologic mapping, *Geothermal studies, Heat transfer.

The existing USSR hydrogeothermal maps of the active water exchange zone are described and analyzed. The first hydrogeothermal map of the USSR was prepared in 1962. Geothermal maps, compiled without consideration of hydrogeological features, had been prepared before this date. The 'Hydrogeothermal Atlas of the USSR,' published in 1975-77, included maps of geoisotherms of the neutral layer (average long-term groundwater temperature), geoisotherms of depths of 125 and 250 m, and other related maps. Thermometric investigations showed that the mean differences between regional geotemperature field and actual temperature measurements were 0.2 C at 25 m depth and -3.0 C at 125 m depth. Conclusions reached on the basis of these maps were that low heat fluxes are present for depths of 250 m in the northern regions of the country and that the geotemperature and thermal fields to at least 250 m were formed under exogenic rather than endogenic influences. The neutral Layer iiin the USSR is mainly within 15-25 m in regions of clays, peats, and loams. In central regions of the European USSR the thickness of the layer of annual variable temperature exceeds 35 m because of the predominance of sands and loam sands and the confinement of the regions to the zone of surplus water. (Cassar-FRC)
W82-06782

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,
Novosibirsk State Univ. (USSR).
M. T. Gladyshev.

Recent work (1974-80) on numerical methods for calculating flows in hydraulic engineering, as developed at Novosibirsk University, is reviewed. The methods are based on numerical solutions of St. Venant equations for one-dimensional unsteady flows. A General Statement of the problem of two-dimensional unsteady flows was formulated, allowing isolation of the breakthrough wave and moving boundary along a dry bottom. Three types of problems were solved by finite difference methods: smooth flows in a channel with vertical walls, discontinuous flows in a channel with vertical walls, and propagation of a breakthrough wave along a dry and wet bottom with isolation of the leading edge. Two-dimensional flows were calculated for the problem of dam failure in the case of a dry and wet bottom. Many experiments were carried out for the case of moving boundaries of liquid layers. For example, the method of moving meshes was used in problems of the inflow of a heavy liquid into a channel with a light and also on failure of a dam with a two-layer reservoir. (Cassar-FRC)
W82-06784

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-1, 1981. 225 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Apalachicola River basin, Choctawatchee River basin, Blackwater River basin, Escambia River basin, Perdido River basin, Alabama River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs, and water levels in wells. This report contains discharge records for 49 gaging stations, stage only for 15 gaging stations, stage and contents for 8 lakes and reservoirs, water quality for 34 gaging stations, and water levels for 11 observation wells. Also included are 21 low-flow partial-record stations, 16 crest-stage partial-record stations, 7 flood hydrograph partial-record stations, and 8 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGUOULA, AND TENNESSEE RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-2, 1981. 483 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Stream-flow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Tombigbee River basin, Mobile River basin, Dog River basin, Pascagoula River basin, Tennessee River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 48 gaging stations, stage only for 7 gaging stations, stage and contents for 4 lakes and reservoirs, water quality for 46 gaging stations, and water levels for 46 observation wells. Also included are 3 low-flow partial-record stations, 4 crest-stage partial-record stations, 4 flood hydrograph partial-record stations, and 101 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systeatic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2A, 1981. 564 p, 14 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous or daily discharge for 82 streams, periodic discharge for 1 stream, peak discharge for 2 streams, continuous or daily stage for 21 streams, periodic stage for 37 streams, continuous elevations for 15 lakes, periodic elevations for 4 lakes, and quality of water for 136 surface-water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State, and Federal agencies in Florida. (USGS)
W82-06955

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2B, 1981. 322 p, 18 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, Water analysis, Water temperature, Chemical analysis, Wells, Water level, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous ground water levels for 178 wells, periodic ground water levels for 178 wells, miscellaneous water level measurements for 539 wells, and quality of water for 282 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-06956

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190356, Price codes: A12 in Paper copy, A01 in Micro-

LIBRARY U. OF I., URBANA-CHAMPAIGN

fiche. Water-Data Report OR-80-1, 1981. 244 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Eastern Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and resrvoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06957

8. ENGINEERING WORKS

8A. Structures

DEVON FLOODS AND THE WATERWAYS OF BRIDGES,
A. B. George.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 125-134, March, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Bridges, *Channel scour, *Flood damage, Flood channels, Flood control, Flood flow, Flood frequency, Devon, Rivers, Design criteria, Highways, Annual floods, Historic floods, Channel improvement.

Floods in Devon in 1952, 1960, 1968, and 1979 caused widespread bridge destruction. Damage in the region was caused by the intensive energy of the flowing water in the steep terrain and by inundation. Return peiods of the floods varied from 6 to 600 years and reatios of major flood to mean annual flood were up to 3.31. It is suggested that mean annual flood be calculated using an equation with more independent variables (area, soil type, and one day net rainfall for a 5 -year return period) than the commonly used formula, which uses area as its only dependent variable. Bridges should be designed to withstand a 1000-year flood at a location immediately downstream of a community, a 150-year flood for bridges carrying motorways and trunk roads, a 30-150-year flood for bridges carrying less important roads, and a 5-year flood for submersible bridges in very rural areas. All bridges should pass the mean annual flood at or below bank-full level. (Cassar-FRC)
W82-05948

PLANNING SRI LANKA'S VICTORIA SCHEME,
Preece, Cardew and Rider, Brighton (England).
J. C. Bennett, and T. G. Carpenter.
International Water Power and Dam Construction, Vol 34, No 5, p 67-73, May, 1982. 8 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Dam design, Irrigation, Victoria Dam, *Sri Lanka, Mahaweli Ganga, Reservoirs, Planning, Arch dams.

The planning process for Sri Lanka's Victoria multipurpose dam scheme on the Mahaweli Ganga is described. The proposed project, scheduled for completion in 1984-85, will provide power and irrigation water for the region until 1990. At that time the installed capacity will be doubled to about 420 MW to handle peak demands. A double-curvative arch dam of 118 m maximum height and normal top water level of 438 m was found suitable for the site at Victoria Falls near Kandy. (Cassar-FRC)
W82-05979

COLD REGIONS ENGINEERING IN NORWAY,
Norwegian Road Research Lab., Oslo.
K. Flaate.
Civil Engineering (New York), Vol 52, No 4, p 68-69, April, 1982. 5 Fig.

Descriptors: *Ice, *Road construction, Frost heaving, Cold regions, Roadbanks, Highways, Paving, Design criteria, Construction, Tunnels, Freezing, Ice formation, *Norway.

In much of Norway and other cold regions, damage from frost-heaving, icing of roads, freezing of water pipes, and reduced bearing capacity of subsoil are common. In the last two decades Norwegian engineers have concentrated their efforts on research and practical solutions to these problems, with excellent results. Cracking of asphalt paving can be reduced by reinforcement with steel mesh or a mesh of other suitable materials. Monitoring is performed throughout the year to evaluate the bearing capacity of the roads. If the freezing index exceeds a given level, it is necessary to insulate the drainage system around a tunnel. Since there is not much loss of heat due to radiation inside a tunnel, the icing problem is not as severe as in the open, and a rather thin pavement above the insulation will be sufficient. (Baker-FRC)
W82-06000

DESIGN TECHNIQUE DEVELOPMENT FOR DAMS IN SOUTH AFRICA,
Department of Environmental Affairs (South Africa).
W. C. S. Legge.
Aqua, No 2, p 378-380, 1982.

Descriptors: *Design criteria, *Dam design, *Dam construction, Concrete dams, Earth dams, Rockfill dams, *Reservoir construction, *South Africa, Dams, Dam foundations, Dam stability, Rock mechanics, Soil mechanics, Tensile stress, Reservoirs, Construction, Technology, Engineering.

Over the past 80 years, the construction of dams and reservoirs in South Africa has been influenced by developments in engineering technology. In the 1930's, the science of soil mechanics was applied to dam construction, while the instrumentation of early concrete arch dams was confined to deflection surveys. After World War II, the design of arch dams was improved from the trial load method through wire models and deflection models to the analytical methods of finite element type presently in use. Improvements in techniques for placing mass concrete aided in the construction of several large dams, while a better understanding of the elasticity of earthen embankments was developed. The ability to move large volumes of earth and rockfill has allowed the construction of earth and rockfill embankments where the construction of concrete dams is not feasible. The latest design technologies allow engineers to test dam safety features as well as the tensile forces on the upstream face of arch dams. (Geiger-FRC)
W82-06011

SOME GEOTECHNICAL ASPECTS OF THE CONSTRUCTION OF THE 'SAFETY RESERVOIR BROECHEM',
Antwerp Water Works (Belgium). Dept. of Civil Engineering.
H. Crommelinck, and J. Dirickx.
Aqua, No 2, p 385-396, 1982. 19 Fig.

Descriptors: *Reservoir storage, *Reservoir construction, *Earth dams, *Storage reservoirs, *Design criteria, Construction, Reservoirs, Reservoir linings, Hydraulic-fill dams, Reservoir siting, Site selection, Storage, Drinking water, Water supply, Water supply development, Earthworks.

The Antwerp Water Works of Belgium has decided to erect a security reservoir to ensure that the surface waters of the river Meuse will be able to supply drinking water to about 1 million people. A construction site along the adduction area of the Albertcanal and in the vicinity of the Oelegem treatment plant was chosen for the Brochem Reservoir, which will support a useful capacity of 4.5 million cu m raw water. Water will be transported by gravity to the nearby treatment works. After pilot studies on compaction techniques, the earth dam was compacted by vibroflotation and squeezing of mud with compacted gravel. Sounding tests showed adequate compaction by these methods of the clayey deposit and sandy hydraulic fill to be used as the foundation of the 10 m high reservoir. After extensive calculations of membrane requirements, a membrane composed of mainly nylon-reinforced bitumen with a polyethylene sheet was chosen to line the slopes of the reservoir. The bottom of the reservoir was waterproofed by clayey particles from the raw water of the Albertcanal. A permanent drain was constructed to handle accidental seepage through the bottom of the reservoir due to cracks of fissures in the waterproof membrane. The reservoir may be used in 1982 after the electro-mechanical installation is completed. (Geiger-FRC)
W82-06012

THE BIESBOSCH WATER STORAGE SCHEME,
Biesbosch Water Storage Corp. (Netherlands).
P. L. Knoppert, and E. G. H. Vreedenburgh.
Aqua, No 2, p 381-384, 1982. 3 Fig.

Descriptors: *Reservoir construction, *Reservoir design, *Reservoir storage, Safe yield, Multipurpose reservoirs, Water supply development, Reservoirs, Water quality control, Reservoir linings, Reservoir sites, Storage reservoirs, Multireservoir networks, Dikes, Earthworks, Construction.

The western and northern parts of the Netherlands rely mainly on fresh surface water from the Rhine and Meuse Rivers for their drinking water supplies. Problems with salt water intake into water treatment plants in 1963 caused the local governments to look to the river Maas to supply a higher quality drinking water source for the Rotterdam area. The construction of reservoirs in the Biesbosch, a deltaic area south of Rotterdam, was necessary to store water from the Maas to bridge periods of low flow and improve water quality. Calculations to determine the safe yield, required volume for bridging functions, and required volume for improved water quality were made for the three reservoirs of the Biesbosch water storage scheme. A second planning phase will provide for an extension with a fourth reservoir. Reservoirs were constructed partly by raising the water level above the surrounding area by dikes and partly by excavating the ground between the dikes. Dikes were lined with a membrane of nylon fabric placed on sand-tight fabric overlined with stone. The completed reservoir area was landscaped to maximize the recreational functions of the area while minimizing interference with the natural deltaic creek system and existing agricultural polders as much as possible. The safe yield storage of the first three reservoirs amounts to 250 million cu m/yr, a figure which will increase to 500 million cu m/yr when the fourth reservoir is built to meet increased water quality and quantity demands. (Geiger-FRC)
W82-06014

BLOOMINGTON LAKE - POTOMAC RIVER WATER RESOURCES PROJECT,
Army Engineer District, Baltimore, MD.
J. W. Peck.
Civil Engineering (New York), Vol 52, No 6, p 47-49, June, 1982.

Descriptors: *Dams, *Construction, *Design criteria, Construction materials, Water quality, Flood control, Bloomington Lake, *Bloomington Dam, *Potomac River, Maryland, *Earth dams, Cofferdams, Rockfill dams, Rolled-earth dams, Dikes, Earthworks.

The Bloomington Dam is located about a 4 hr drive west of Baltimore on the Potomac River.

The complex planning of the project took almost 19 years, and it consists of a main embankment, dike, spillway, intake tower, tunnel, and other structures. In order to construct the dam, relocation of a railroad, highways, and utilities was required. Twenty construction contracts were awarded, for a total construction cost of $174,300,000. The dam embankment is a rolled earth and rockfill structure founded on bedrock throughout. It has a maximum height of 296 feet above streambed, a crest length of 2,130 feet, and is comprised of a total volume of 10.5 million cubic yards of earth and rock fill. In a saddle a short distance from the left abutment of the dam is a dike embankment which is a rolled earth and rockfill structure having a height of 89 feet, a crest length of 880 feet and a total volume of over 1 million cubic yards. One of the major concerns with embankment construction is the contact surface between the embankment and foundation surface. Extensive use was made of mini-cam photogrpahy equipment to constantly record various features of the work as it progresssed. A small dike was constructed to divert the river into the completed outlet tunnel so the cofferdam and foundation preparation work could be done. Flood control will provide major benefits to the downstream communities some 25 miles below the dam. Water quality accounts for 51% of the benefits of this project. Value engineering was used effectively throughout the construction of the project, with over $3 million in savings realized. (Baker-RC)
W82-06183

OLMOS DAM MODIFICATION.
Civil Engineering (New York), Vol 52, No 6, p 54-55, June, 1982. 2 Fig.

Descriptors: *Dams *Flood control, Construction, Olmos Dam, Design criteria, Spillways, *Texas, San Antonio River

Olmos Dam is located on Olmos Creek, which is a tributary of the San Antonio River northeast of the central business district of San Antonio, Texas. In 1973 a study disclosed that flood routings produced by severe storms over the drainage basin would overtop the dam by varying amounts, and the structure would be overstressed beyond the permissible limits of current design. The reduced factors of safety could have resulted in failure. Olmos dam is a dry reservoir dam, holding water only as a result of heavy rains flooding the area. The safety study suggested several modifications, including provisions of an ogee spillway section with flip bucket at the central portion of the dam structure with crest at elevation 728, 1287 feet long, capable of passing the probable maximum flood. The Olmos Drive roadway across the top of the dam was to be removed. A new gate operating room was to be built atop the non-overflow section. Increased stability of the spillway portion was achieved by addition of mass concrete. Dam stability was increased in the non-overflow portions by vertical prestressing of the dam structure. Modifications to retain the 200 year flooding flow with zero outflow for some hours for staged release in consideration of potential impact on the downtown area of a flood were made. The relocation and reconstruction within the dam structure of major telephone trunk line were performed and an inspection gallery was provided. One problem during construction was excessive groundwater in the limestone stratum at the contact plane for the dam. (Baker-FRC)
W82-06186

SAFETY ASPECTS IN THE DESIGN AND INSPECTION OF DAMS,
COBA-CONSULPRESA, Lisbon (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 34, No 5, p 45-47, May, 1982. 8 Ref.

Descriptors: *Dam failure, *Design criteria, *Safety, Gravity dams, Buttress dams, Arch dams, Earth dams, Rockfill dams, Spillways, Outlets, Errors, Inslpection, Dam construction, Dam design, Dam foundations, Dam stability.

A listing of scenarios for rupture and hazard scenarios (serious incidents) can help in design of new dams, in judging the safety and reliability of old dams, and in avoiding most human errors. Dam failures depend on height (low dams fail more often than high dams), type of dam (arch dams are are most stable), materials (earth dams are most vulnerable), location, age (very new and very old dams are most likely to fail), and quality of design. Overtopping accounts for a third of disasters. Other causes are piping, abnormal uplift, foundation defects and wearness, earthquakes, weak materials, erroneous design, and poor construction. A listing of hazard scenarios is given for all types of dams. This includes sudden filling of a lake and overtopping of a dam, closure of a valley by mountain movement, piping, ground differential motion at the foundation, inadequate design, faulty construction, and subsidence of the foundation from earthquakes or subterranean water drainage. Additional hazard scenarios are given for specific types of dams: gravity, buttress, arch, multiple arch, earth, rockfill, spillways, and outlets. (Cassar-FRC)
W82-06203

THE ITAIPU HOLLOW GRAVITY DAM,
Promon Engenharia, Sao Paulo (Brazil).
D. M. Caric, L. P. Eigenheer, J. Uriarte, A. Szpilman, and A. Gallico.
International Water Power and Dam Construction, Vol 34, No 5, p 30-44, May, 1982. 19 Fig, 5 Tab, 14 Ref.

Descriptors: *Hydroelectric plants, *Dam design, Itaipu Dam, Brazil, Paraguay, *Parana River, Hollow dams, *Gravity dams, Dam construction, Concrete dams, Hydraulic structures, Dam foundations, Grouting, Drainage, Stress analysis, Dam stability, *Hollow construction dams.

The civil works at the Itaipu hollow gravity dam on the Parana River, Brazil-Paraguay, are scheduled for completion by the end of 1982. The structure is 612 m long and consists of 18 blocks each 34 m wide. The blocks range from 100 to 196 m high, making Itaipu the highest hollow gravity dam in the world. The 1260 MW final capacity and annual generation of 75,000 GWh will make this the largest power station in the world when it is completed in 1988. The hollow construction requires 25% less concrete than solid construction, has better stability against overtopping, better head dissipation, greater construction flexibility, less hydraulic uplift, more effective drainage, and 12% lower costs. However, the concrete for a hollow dam requires a higher proportion of cement, more framework, more complex concrete shapes, a complex benched excavation on sloping abutments, some steel reinforcement, and higher engineering costs. Nevertheless, the the Itaipu dam the hollow construction gave a savings of 1.3 million cu m of concrete and 6 months of construction time. Detailed descriptions and drawings are given for the hollow block shape, longitudinal and transverse contraction joints, and concrete temperature control. The foundation's geology, configuration, treatment, grouting, and drainage are described. Stress and stability tests are also discussed. (Cassar-FRC)
W82-06205

INVESTIGATION OF THE OVERFLOW SPILLWAY OF THE VELISHCHAI RESERVOIR.
Z. A. Musaev
Hydrotechnical Construction, Vol 15, No 7, p 414-417, 1981. 2 Fig, 2 Tab, 2 Ref. Translated From Gidroteknicheskoe Stroitel'stvo, No 7, p 25-27, July, 1981.

Descriptors: *Spillways, *Reservoirs, *Intake gates, *Design criteria, *Dam construction, *Model studies, *Wave action, Dams, Reservoir storage, Mathematical studies, Mathematical models, Aeration

The proposed design of the overflow spillway of the Velischai reservoir which was constructed to irrigate the lands of the Masally region of the Azerbaidzhan SSR was investigated. The height of the side walls was determined without considering the occurrence of aeration of the flow and rolling waves. Experimental data on aeration and wave formation on the conveyance flume was obtained for a parapet design with one-way overflow of water. Studies on two-way overflow revealed an improved hydraulic regime of flow both in the intake and in the horizontal section of the spillway model. By arranging the intake flume angles at 80 degrees to the axis of the dam, a two way intake in the given layout of the hydrodevelopment was achieved. With a specific parapet design, the useful storage of the reservoir was increased by raising the elevation of the spillway sill of the intake part without increasing the amount of works on the dam. This produces additional net income during the payback period, resulting in greater annual savings. (Geiger-FRC)
W82-06220

REGIONAL DETENTION BASINS FOR STORMWATER CONTROL,
Whiteley-Jacobsen and Associates, Portland, OR.
G. E. DiLoreto.
Public Works, Vol 113, No 5, p 61-62, May, 1982. 1 Fig.

Descriptors: *Storm water, *Detention reservoirs, *Drainage systems, Storm runoff, St. Helens, *Oregon, Design criteria, Runoff, Urban Runoff, Controlled drainage.

Regional detention basins were chosen as the best storm water control option at St. Helens, Oregon, since the topsoil overlying impermeable basalt is only 1-2 feet deep, precluding economical construction of drainage pipes and open channels. Maintenance costs associated with a few large regional basins are much less than costs of hundreds of small detention ponds. Design considerations for regional detention basins are: sediment traps, consideration of soil characteristics and groundwater table, a bank slope of 3:1 horizontal and vertical, low flow bypass channels, emergency spillways for events exceeding the design storm, maximum depth of 4 ft with 1 ft of freeboard, a 1% bottom slope toward the low flow bypass channel, and stabilized banks. (Cassar-FRC)
W82-06225

SAFETY OF DAMS (SICHERHEIT VON TALSPERREN),
Technische Univ., Munich (Germany, F. R.). Lehrstuhl fuer Wasserbau.
H. Blind.
Wasserwirtschaft, Vol 72, No 3, p 84-90, 1982. 8 Fig, 4 Tab. English Summary.

Descriptors: *Safety, *Dams, *Dam failure,*Design criteria, Dam design, Control systems, Statistics, Data collections, Accidents, Erosion, Subsoil, Flooding, Dam stability, Geology, Hydrology, Hydraulic engineering.

Dam failures and their causes are discussed, and measures to improve the safety of dams are suggested. Registration of all new dams and the reporting of damage thereto is urged so that the analysis of these data may lead to improved design and construction. It is not possible to extrapolate a probability figure for dam failure. Problems with data so far collected (e.g., the International Conference on Large Dams World Register of Dams) include insufficient information, the necessity of using simplified definitions because each case is individual, lack of investigation of the cause of accidents, and differences in environment, design, and construction. Statistics show that causes of failure for earth dams include flooding at high water due to failure of spillways or gates, internal erosion near the foundation, settling of the dam or foundation, contact erosion, inhomogeneity of subsoil, liquefaction, and piping effect; for masonry and concrete dams, causes include insufficient shear strength in the foundation bottom, too great an upward hydraulic pressure on the foundation, lack of stability of the dam, abnormal plasticity of the subsoil and high permeability, and seepage and erosion in the foundation bottom due to permeability. To improve dam safety, certain principles of design and construction should be followed. These include the use of well-qualified engineers and

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reliable business firms, thorough site studies, especially in hydrology and geology, careful consideration of design flood and the hydraulic requirements of tail flow, study of the plasticity of the dam and subsoil, a constructive conception of bottom sealing for permeable rock, installation of an observation and control system, the capability of performing future renovations, and the ability to build the dam in a given time. (Gish-FRC)
W82-06236

INFLUENCE OF REMEDIAL MEASURES ON THE MOHNE GRAVITY DAM (EINFLUSS DER SANIERUNGSMASSNAHMEN AUF DIE MOHNEMAUER),
Ruhetalsperrenverein, Essen (Germany, F. R.).
K. -H. Idel, and P. Rissler.
Wasserwirtschaft, Vol 72, No 3, p 130-134, 1982. 4 Fig, 3 Tab, 1 Ref. English Summary.

Descriptors: *Gravity dams, *Renovations, *Grouting, *Drainage engineering, Reservoirs, Mohne reservoir, *West Germany, Maintenance, Seepage, Water pressure, Thermal stress, Strength, Hydraulic engineering, Permeability, Construction, Dam construction, Damage, Aging.

Renovations were carried out on the masonry gravity dam of the Mohne Reservoir, West Germany, between 1972 and 1978 to counteract the destructive effects of aging and of air raids during World War II. In 1943 the middle section of the dam was destroyed in an air attack, and hasty repairs resulted in uncontrollable seepage in this section. Damage appearing in later years included increasing permeability of the dam, damage to the face masonry, thermal stressing of the parapet, and increasing seepage under and around the dam. The greatest permeability was measured in the subsoil of the barrage sides. Comprehensive grouting and drainage procedures were necessary to renew the sealing of the dam and subsoil and to control water pressure distribution in the dam and foundation joint. A work, drainage, and control gallery was constructed at the bottom of the dam wall for grouting. In addition, the head of the dam wall was compressed from above. Drainage bores were laid out at 1-m intervals to reduce water pressure. The crown of the dam wall was also renovated. A pendulum sounding lead and three single extensometers were installed to measure slippage, and control bores were drilled to measure bottom pressure and seepage. Analysis of slippage measurements made before and after renovations showed greater horizontal slippage after renovation and suggested that compression work had caused an irreversible slippage of the foot of the wall 3-5 mm toward the air side. However, in general, water-level dependent distortion was reduced by the renovations. It was concluded that the dam crown had become stiffer as a result of compression. The drainage system was successful in both removing water and reducing bottom pressure, the latter being important for the shock and slip resistance of the dam. (Gish-FRC)
W82-06239

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMIDICHTUNGEN),
For primary bibliographic entry see Field 8G.
W82-06241

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),
Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8C.
W82-06242

OPTIMAL RISK-BASED HYDRAULIC DESIGN OF BRIDGES,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y.-K. Tung, and L. W. Mays.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 191-203, June 1982. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Hydraulic design, *Bridge design, *Flood damage, Hydraulic structures, Optimization, Risks, Embankments, Leaf River, Hattiesburg, Mississippi, Model studies, Hydrologic models, Highways, Damage, Cost analysis, Backwater, Erosion, Bank erosion, Design criteria, Construction costs.

Hydrologic uncertainties annd socioeconomic effects are incorporated into the hydraulic design of highway bridges to determine the best design for the lowest cost. Using this method, bridge openings and embankment heights can be chosen to avoid overdesign. The cost components involved in risk-based hydraulic design of bridges are construction cost, flood damage cost, backwater damage cost, traffic interruption cost, and embankment repair cost. The optimization technique, the Hooke-Jeeves pattern search, is applied to design of a bridge on the Leaf River near Hattiesburg, Mississippi. Results show that the optimal bridge openings are the same length for the various probability models (normal, lognormal, Gumbel, Pearson III, log-Pearson III, and composite) and parameter estimation procedures, but the embankment heights vary by 1.8 ft. In this example the jacknife and bootstrap methods produce nearly the same optimal solutions. Construction costs were computed at $217,800 and expected annual damage costs from $55,000 to $110,800 depending on the hydrological probability model used. (Cassar-FRC)
W82-06432

PROBLEMS IN TUNNELLING BY PIPE JACKING AT TILEHURST,
Thames Water Authority, London (England).
S. H. Shurlock.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 151-153, March, 1982. 2 Fig.

Descriptors: *Tunnel failure, *Pipe jacking, Tunnel construction, Tunneling, Reading, England, Tilehurst.

Pipe jacking was the technique chosen for a 130 m tunnel project, part of a new outlet system from the Tilehurst service reservoir at Reading, England. The tunnel drive began through stiff blue London Clay. After 10 m brown clay appeared and at 24 m the face collapsed, dumping 3 cu m of gravel and soft clay plus a large quantity of water. The blue clay layer totally disappeared and wet conditions prevailed thereafter. After 37 m into the tunnel some joints were broken or displaced, and gravel and water became a constant problem. Of 54 joints, 19 were visibly damaged and 6 others showed groundwater inflow. The tunnel varied from a straight line by + or - 72 mm in level and + or - 84mm in line. Direction changes reached the 1 degree maximum recommended deflection. A welded steel lining was eventually inserted to repair the damage. The actual tunnel cost was 112,000 pounds vs. the planned 72,000 pounds. Several conclusions were reached from this experience: (1) test boreholes should have been much closer together, (2) pipe jacking is a good procedure, but the joints are a major weakness, (3) existing techniques are suitable for short drives but not adequate for long drives unless very good conditions prevail, and (4) apparently sound joints can be badly spalled on the outside. (Cassar-FRC)
W82-06448

THE APPLICATION OF MICROCOMPUTERS TO THE DESIGN OF STORM SEWER SYSTEMS FOR SMALL AREAS,
Sunderland Polytechnic (England). Dept. of Civil Engineering.
B. Archer.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 113-117, March, 1982. 5 Ref.

Descriptors: *Sewer systems, *Pipes, *Drainage systems, Computers, Design criteria, Rainfall intensity, Urban drainage, Storm sewers.

Microcomputers can advantageously be used to design storm sewer systems. Charts and tables for pipe sizing and for rainfall intensity are replaced by rapid calculations from the basic equations. Pipe sizes are determined within seconds, compared with the several hours necessary for manual methods involving tables. Effects of changing depths, pipe inverts, pipe lengths, or areas to be drained can be quickly determined. An appendix describes the outline flow chart for the prgrams, lists the program, and illustrates use of the program. (Cassar-FRC)
W82-06449

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-06452

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,
University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
For primary bibliographic entry see Field 5F.
W82-06453

MAJOR FACTORS IN SEWER VENTILATION,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. B. Pescod, and A. C. Price.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 385-397, April 1982. 10 Fig, 9 Tab, 4 Ref.

Descriptors: *Sewer systems, *Ventilation, *Air circulation, Temperature effects, Corrosion, Hydrogen sulfide, Dissolved oxygen, Corrosion control.

As part of an effort to develop a design to produce a maximum ventilating air flow within a sewer system having ventilation stacks without using mechanical means, an investigation of the major factors affecting naturally-occurring air flows in sewers and undertaken. The five factors considered to be the major contributors to sewer ventilation are the action of wind passing across the ventilation stack, the friction at the air-water interface resulting from the wastewater flowing down the sewer (wastewater drag), the rise and fall of the wastewater level, temperature differentials between the air and the sewer, and differences in the barometric pressure across various parts of the system. The influence of the last three factors can be treated in an analytical manner by representation in terms of the volume of air turnover produced by the rise and fall of the wastewater, having either assumed or measured a pattern of flow, or as an additional driving pressue head in the cases of the temperature and baromeric pressure differentials. Full-scale ventilation stacks were tested in a low-velocity wind tunnel using various terminals for the educt stack to try to find a stack shape which would maximize the wind across stack effect. The wastewater drag effect was investigated through measurement of air velocities using a gas tracer technique. The wind tunnel tests resulted in the identification of extraction rates that can be produced by low wind speeds at the educt stack location from which a typical daily or weekly extraction rate can be estimated under natural conditions. The wastewater drag effects appear to be subservient to wind extraction. The variability of wastewater level in a sewer system results in addition fresh air being drawn in during a fall in level and sewer air being exhausted during a rise in level. Temperature differentials in the summer can be expected to increase resistance to air movement in the sewer. Significant differences in barometric pressure would not be expected to arise during the summer months in the United Kingdom. (Carroll-FRC)
W82-06462

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,
P. J. Mason.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 209-219, May, 1982. 4 Fig, 44 Ref.

Descriptors: *Energy dissipation, *Dam design, *Outlets, Flip buckets, Hydraulic design, Ski jumps, Jets, Damage, Erosion, Cavitation, Hydraulic jump, Discharge capacity, Rock basins, Baffles.

A survey was conducted at 370 prototype energy dissipators from dams in 61 countries to establish the ranges of head and flow for which designers have selected various dissipators and at which problems are most likely to occur. Rock basins are predominantly used for head differences below 30 m. Damages are most likely at head differences above 40 m or in the presence of weak rocks. Simple hydraulic jump stilling basins in concrete are commonly used at head drops of 1-10 m and 30-50 m. At 50 m or above special techniques and materials are necessary to avoid failure. Baffle basins, generally trouble-free over a head drop range of 10-30 m, show erosion, cavitation, and complete destruction at higher head differences. Free trajectory jet dissipators (simple overfalls, ski jumps, and flip buckets) are relatively problem-free for almost any head drop, over 200 m in some cases. A few reported cases of erosion are related to unacceptable scour in the downstream plunge pool. One case of cavitation erosion is documented. A graph shows that free trajectory jet dissipators are rarely used in the range to the left of a line defined by a head drop of 8 m and discharge capacity of zero and a head drop of 48 m and discharge capacity of 10,000 cu m per sec. Results of this survey are summarized on a graph revealing the most practical energy dissipator designs for different combinations of head drop and discharge capacity. (Cassar-FRC)
W82-06500

THE KIELDER TRANSFER WORKS,
D. J. Coats, N. S. M. Berry, and D. J. Banks.
Proceedings of the Institution of Civil Engineers, Part 1, Design and Construction, Vol 72, No 2, p 177-208, May, 1982. 24 Fig, 3 Tab, 38 Ref.

Descriptors: *Pipelines, *Tunnel construction, *Water transfer, Tunnel linings, Kielder Dam, *England, Tees River, Wear River, Tyne River, Water resources development, Reservoirs, Weirs, Pumping plants, Dam construction, Aqueducts, Hydraulic valves.

The transfer works of the Northumbrian Water Authority Kielder water scheme connects the water stored at Kielder Water on the River North Tyne with the rivers Wear and Tees for purposes of flow regulation and water abstraction. Operations are scheduled to begin in 1982. Water abstracted from the River Tyne at the Riding Mill pumping station 56 km downstream from Kielder Dam will flow through 6.2 km of pump main and 32 km of a gravitational system, with connections at the rivers Wear and Tees. The Airy Holm headpond, about 8 km from Riding Mill, permits correction of imbalances between rates of pumping and tunnel discharge. At Riding Mill weirs have been installed to increase the water depth and provide storage. The pumping station contains 12 pump units, each with 91,000 cu m per day capacity. The 65 m long intake has a maximum intake velocity of 0.3 m per sec. The steel pump main rises about 200 m. Air venting houses and access places for cleaning are built into the pipeline. The Airy Holm dam was built with a 180 m long and 20 m high concrete gravity section in the central portion, with earth embankments on the flanks to give a dam 500 m long. A concrete-lined gravity flow tunnel with air shafts and discharge valves at the rivers complete the transfer works. Steel pipe 2.89 m in diameter carries the aqueduct over two river valleys. There are no in-line valves, all control being effected by the discharge valves at the rivers Wear and Tees. The discharge structures are largely underground. (Cassar-FRC)
W82-06502

THE KIELDER WATER SCHEME,
D. J. Coats, and N. J. Ruffle.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 135-147, May, 1982. 5 Fig, 1 Tab, 5 Ref.

Descriptors: Water resources development, *Flow regulation, *Water transfer, Kielder Reservoir, Tyne River, Wear River, Tees River, *England, Reservoirs, Flow augmentation, Recreation, Environmental effects, Water storage, Industrial water, Water supply, Aeration, Water quality control, Public relations, Fish.

The Kielder water scheme was constructed during 1975-82 in northeast England to regulate the Rivers Tyne, Wear, and Tees for supplying water to a region with rising industrial water usage. It is under the jurisdiction of the Northumbrian Water Authority. Kielder Water, a 188 million cu m reservoir on the River North Tyne, provides water for regulation of all three rivers via a north-south transfer works. This consists of a weir and pumping station on the River Tyne, 6.2 km of 2 m diameter pumping main, 32 km of 2.9 m diameter tunnel, and a small head pond at Airy Holm. Aeration was installed in the reservoir to prevent thermal stratification and resulting problems from Fe and Mn compounds, sulfides, and ammonia. During construction truck traffic was limited to an approved route. Public relations with the community remained good throughout construction because of Liaison Officer, located near the headworks, was available for resolving problems and for guiding visitors. Prehistoric, Roman, and medieval sites were investigated before innundation, and the historic 1862 Kielder Viaduct was preserved. The irregularly shaped 1086 ha reservoir, set in coniferous forest, is available for recreational activities such as fishing, boating, camping, and other activities. Since much salmon spawning gravel was inundated, a fish hatchery has been built upstream to release 160,000 juvenile salmon per year. (Cassar-FRC)
W82-06503

THE KIELDER HEADWORKS,
D. J. Coats, and G. Rocke.
Proceedings of the Institution of Civil Engineers. Part I, Design and Construction, Vol 72, No 2, p 149-176, May, 1982. 21 Fig, 2 Tab, 4 Ref.

Descriptors: *Dam construction, *Reservoirs, *Embankments, Kielder Dam, Bakethin Dam, England, Earth dams, Weirs, North Tyne River, Culverts.

Construction details of the Northumbrian Water Authority's Kielder Water are described. This reservoir is part of a scheme to regulate the River Tyne in northeast England. Construction work started in 1975 with relocation of a highway. Preliminary site studies revealed an underlying rock sequence of sandstones, shales, mudstones, and coal seams. The superficial deposits were glacial boulder clay and alluvial material. Bakethin Dam, a 17 m high and 165 m long submerged sand and gravel weir, was built within the main reservoir to retain water in the upper reaches for amenity reasons when Kielder Water is drawn down. The draw-off works consists of a reinforced concrete culvert about 15 m wide containing a 1900 mm diameter scour pipe, a 2000 mm diameter draw-off pipe, an access roadway, instruments, and a valve tower. Construction details and diagrams of the clay core, earth-fill Kielder Dam are described. The dam is 1140 m long, 52 m high. The reservoir is 11.1 km long, 1086 ha in surface area, and stores 188 million cu m of water. Impounding started on December 15, 1980. (Cassar-FRC)
W82-06504

BRIDGING THE WATER SUPPLY GAP,
Bogert (Clinton) Associates, Fort Lee, NJ.
W. Wheeler, and E. Cruz.
Public Works, Vol 113, No 3, p 62-63, March, 1982.

Descriptors: *Pipelines, *Water supply, *Water transfer, Construction, New York, New Jersey, Drought, Bridges, George Washington Bridge, Expansion, Water shortage.

Water from New York's supply system was diverted to drought-stricken northeast New Jersey by a 10,5000 ft long, 24 inch diameter steel pipeline built acress the George Washington bridge over a 4-month period. It was completed on July 1, 1981. The pipeline has a capacity of 20 mgd. Special problems included 9 ft. of expansion and constraction and a 7 ft. sway, heavy vehicular traffic on the bridge (250,000 vehicles per day), the age of the bridge (50 years), and procuring the necessary materials, Since custom expansion joints could not be disigned and made within the time limits, units with 10 inch axial movement each were combined, five for the 48 inch movement at the main span of each tower and two for the 18 inch movement at the side spans. The pipeline is anchored to the bridge only at the center, the unanchored part floating on roller guides. If desired, the pipeline may be dismantled and stored in an abandoned tunnel. (Cassar-FRC)
W82-06508

TEXAS GULF COAST PROJECT ANSWERS VITAL WATER NEED,
Southwest and Texas Water Works Journal, Vol 64, No 2, p 6-7, May, 1982.

Descriptors: *Water supply, *Pipelines, *Reservoirs, Dams, Point Comfort, Texas, Earth dams.

A pipeline and reservoir system is currently under construction to supply water to the Point Comfort region near Houston, Texas. The project consists of the earth-filled, 1.3 mile long, 58 ft high Palmetto Bend Dam, the 11,000 acre Lake Texana, one mile of 36 inch steel above-ground transmission line, and 13 miles of underground pipeline. The dam is constructed with specially covered slopes and extra steel anchors in the concrete spillway to protect against hurricane damage. Initially the reservoir will provide 20,000 acre ft of water per year to the region. (Cassar-FRC)
W82-06519

STANDARD PRACTICE FOR INSERTION OF FLEXIBLE POLYETHYLENE PIPE INTO EXISTING SEWERS--ASTM F585-78.
Water Services, Vol 86, No 1033, p 106-108, March, 1982. 2 Fig, 6 Ref.

Descriptors: *Pipelines, *Sewer systems, *Rehabilitation, Plastics, Standards, Excavation, Inspection, Flow characteristics, Design criteria, American Society for Testing and Materials.

The standard practice reprinted and adapted here (ASTM F585-78) describes the design and selection considerations and installation procedures for construction of new sanitary and storm sewers by inserting polyethylene pipe through existing pipe and along the previously existing line and grade. This procedure minimizes traffic disruption, surface damage, and restoration, with little or no interruption of service. General guidelines emphasize that existing pipe conditions must be determined to see if the pipe insertion is feasible. Generally, piping with outside diameter 10% smaller than the original sewer is practical. To account for external loading, formulas are given for calculating the standard dimensiion ratio of pipe required and the minimum allowable radius of curature for any size and weight of pipe. Other subjects treated under design and selection characteristics are anchoring and encasement, pulling force and length. Procedures are detailed for inspection and cleaning; excavation; storage, handling, and joining of polyethylene pipe; insertion and termination; finishing and restoration; and inspection and acceptance. (Cassar-FRC)
W82-06601

OUT OF SIGHT--OUT OF MIND.
Civil Engineering (London), p 45, 47, May 1982. 1 Tab, 2 Ref.

Descriptors: *Tunnel linings, *Rehabilitation, *Sewer systems, Linings, Polyester resins, Resins, *England.

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Rehabilitation of aging sewers in England has generally been limited to repairing acute failures with the limited available funds. Relining with polymers has been receiving increased attention in spite of its high initial cost. A comparison of the costs for installing several types of polyester concrete, glass reinforced polyester, and other methods showed that these relining methods are generally 4-5 times more expensive than hand repointing. Since relining is still in its infancy, many contractors use it only in sections unsuitable for digging. The problem of detecting voids around the barrel of the sewer is being studied. Base-band radar and gamma ray backscatter have been successful in locating dry voids. Closed-circuit television has also been used to view the condition of the sewer interiors. (Cassar-FRC)
W82-06713

CANAL TUNNEL REPAIR OPTIONS.
Civil Engineering (London), p 56, 58, May, 1982. 1 Fig.

Descriptors: *Tunnel linings, *Canal linings, *Rehabilitation, Linings, Concrete construction, Blisworth Tunnel, *England.

The 2812 m long brick lined Blisworth tunnel, part of Britain's 2000 mile canal system, has been closed to boat traffic since October 1980 because of failures and deterioration. The option chosen for rehabilitation of the 200-year-old structure involves removal of a section of existing tunnel lining and some of the surrounding material and replacing this with an external segmental concrete lining. Although the 4.25 million pound cost is the most expensive of the five renovation alternatives in the short term, maintenance is expected to be minimal. In addition the tunnel's 15 ft width will not be further reduced, retaining the 2-way traffic pattern. Work is expected to start in late 1982. (Cassar-FRC)
W82-06758

SEWER RENEWAL BY PIPE INSERTION.
Civil Engineering (London), p 66-67, May, 1982.

Descriptors: *Sewer systems, *Linings, *Rehabilitation, Polyethylene, Pipes, Plastics.

Insertion of polyethylene pipe into aging sewers provides total renewal for structurally unsound systems as well as corrosion resistance. The winching method of insertion can be used for lengths up to 500 m without diverting flows. Hydraulic jacking needs an insertion pit only 1 m longer than an individual section. However, it is more expensive because smaller lengths and more joints are required. Flows must be diverted. In high water table regions no dewatering or trenching is necessary. There are minimum disturbances to agricultural crops, buildings, and traffic. The small decrease in finished pipe diameter is counteracted by the low friction, infiltration resistant smooth plastic lining. (Cassar-FRC)
W82-06759

REDEVELOPMENT OF AQUEDUCT CROSSING OF MANCHESTER SHIP CANAL AND RIVER MERSEY,
R. J. Baty.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 97-112, March, 1982. 6 Fig.

Descriptors: *Aqueducts, *Tunnel construction, Pipelines, Tunnel linings, Frozen ground, Manchester Ship Canal, Mersey River, Vyrnwy Aqueduct, Diversion structures, *England.

The aqueducts crossing the Manchester Ship Canal and the River Mersey were first put into service in 1892. The section under the canal was a 3658 mm diameter brick tunnel, built before the ship canal was filled with water. The section under the river was a 2748 mm diameter tunnel built of cast-iron sections bolted together. Within these tunnels pipelines were installed in 1892 and 1905. A third pipeline, added in 1938, fit within the canal tunnel. However, in order to pass under the river it was necessary to construct a second tunnel crossing the Mersey. Water resources developments during the 1960's required further modifications to the system. Deterioration of some of the old pipe necessitated remedial work. The North West Water Authority accomplished this by linking the two existing river crossing tunnels and replacing the pipes with a single pressure lining occupying the full area of the tunnel. This paper discribes the reconstruction work in detail. After construction of a temporary diversion pipework, the connecting shaft was built using a local ground freezing technique and precast concrete segments. The old brickwork and cast-iron segment tunnels, in excellent condition, were lined with pressure-resistant steel 16 mm thick in 6 and 3.6 m lengths. At the tops of the shafts shear walls penetrating the bedrock were constructed to compensate for thrust forces. The project began in October 1978 and was completed in spring 1981. (Cassar-FRC)
W82-06813

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),
Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).
J. Bauer.
Wasserwirtschaft, Vol 72, No 1, p 6-11, 1982. 7 Fig.

Descriptors: *Airports, *Hydraulic engineering, *Diversion ditches, *Water table, *Wastewater facilities, Storm wastewater, Storm sewers, Drainage ditches, Drainage effects, Environmental effects, Construction, Engineering, Agriculture, *West Germany, Drinking water, Soil mechanics, Geology.

Water-related problems caused by the site selection for the new Munich (West Germany) airport and the solutions to these problems are described. The site is at the northern edge of the Munich gravel plain, with a topsoil that was once peat but is now used for intensive agriculture. Under the permeable quaternary gravel lies an impermeable layer that separates the groundwater into upper and lower regions, the lower region being used for drinking water. It was important that airport construction not disturb this arrangement. Several small streams running from southwest to northwest would be diverted around the airport by channels built to a design flood of 20 years, the main outfall ditch being built to a 100-year flood. The airport would also be protected by a dike along the channel walls. The groundwater table would be lowered by means of drainage ditches to prevent frost formation on the runways. In order to avoid a negative effect on the surrounding agricultural lands, a plan was chosen such that the lowering of the water table is only noticeable to the south (upstream) of the airport, and then only after a long dry spell; in order to avoid negative effects to the north, water collected in the drainage ditches would be allowed to seep out through 120 vertical shafts along the northern perimeter of the airport. Stormwater would be channeled into a combined system for domestic and industrial wastewater as well as stormwater from streets and parking lots and a separate stormwater system for lightly polluted stormwater and stormwater overflow. The construction of an underground rail line connecting the airport with the city posed the problem of avoiding a build-up of groundwater, since the tunnel would cut off its flow. It was decided to collect water on the upstream side in horizontal filters and carry it to downstream horizontal filters by means of control shafts along the tunnel walls which would be connected to deep siphons. (Gish-FRC)
W82-06825

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
For primary bibliographic entry see Field 6B.
W82-06869

HYDRAULIC MODEL STUDIES - YELLOWTAIL AFTERBAY DAM SLUICEWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. F. Young.
Report GR-82-5, July, 1982. 47 p, 24 Fig, 2 Tab, 3 Ref.

Descriptors: *Supersatuation, *Hydraulic models, *Dam effects, *Gases, *Flow deflectors, *Sluiceways, Model studies, Fishkill, Dam design, Stilling basins, Flow velocity, Debris, *Montana.

Yellowtail Afterbay Dam is on the Big Horn River 3.5 km below Yellowtail Dam and Powerplant. Releases from the afterbay dam are used to provide uniform daily flow in the Big Horn River, leveling the peaking power generation from Yellowtail Powerplant. At times, gas supersaturation has occurred downstream from Yellowail Afterbay Dam, resulting in serious fish kills. A 1:24 scale model of Yellowtail Afterbay sluiceway was constructed to study the placement of flow deflectors designed to keep the water jets issuing from the sluiceway gates near the tailwater surface. Deflector plates installed on the curved invert of the sluiceway will reduce jet submegence, a cause of supersaturation. Measurements show no subatmospheric pressures present on the flow deflector lips. Waves within the stilling basin will be larger with the deflectors in place than with the existing configuration, while waves outside the basin will be the same size or smaller. With the flow deflectors in place, the largest velocities, and therefore the most flow, occur near the surface where the pressure is close to atmospheric. With the deflectors in place, material will not be brought back into the basin, although any material thrown into the basin will remain there. (Moore-SRC)
W82-06962

8B. Hydraulics

ON CONDUCTING THE MODIFIED 'SLUG' TEST IN TIGHT FORMATIONS,
Geological Survey, Reston.
C. E. Neuzil.
Water Resources Research, Vol 18, No 2, p 439-441, April, 1982. 5 Fig, 3 Ref.

Descriptors: *Well hydraulics, *Hydraulic properties, *Test wells, *Rock mechanics, Permeability coefficient, Storage coefficient, Equilibrium, Head loss, Compressibility, Transmissivity, Wells, Hydraulics, Shales, Pumps, Slug test.

An improved version of a modified 'slug' test (Brdehoeft, J. D., and Papadopulos, S. S., 'A method for determining the hydraulic properties of tight formations, 'Water Resources Research, Vol. 16, No. 1, p 233-238, 1980) is presented. With the original method, the borehole is filled with water prior to the test, usually resulting in significant transient flow; the necessary condition of approximate equilibrium is therefore not met. Additionally, while the compressibility of water (Cw) should be used to account for storage change in the shut-in well, actual compressibility in this well can be larger than Cw. With the improved method, the borehole is filled with water and two packers are placed close together. Pressure is monitored by two transducers, one between the packers and one below the lower packer. The test section is shut in, and pressures in both sections are monitored until near-equilibrium exists. To compute compressibility in the well, the volume of water pumped in to achieve the pressure 'slug' must be known; this is calculated by measuring the amount of water pumped from a container at the surface. The possibility of generating a suction in the uppermost part of the shut-in volume and the creation of a free surface is prevented by locating the valve used to shut the well near the packers. (Gish-FRC)
W82-06060

BICYCLE-SAFE GRATE INLETS STUDY; VOLUME 5 - HYDRAULIC DESIGN OF GENERAL SLOTTED DRAIN INLETS,

Water and Power Resources Service, Denver, Colorado.
C. A. Pugh.
Federal Highway Administration Report FHWA/RD-80/081, October 1980. 145 p, 120 Fig, 6 Tab, 1 Ref. PO-5-3-0166.

Descriptors: *Inlets, *Hydraulic design, *Hydraulic models, *Storm drains, Model studies, Flow characteristics, Interception, Slopes, Flow capture.

Hydraulic tests and analysis were conducted to generalize the hydraulic design of slotted drain installations. Slotted drains with solid vertical spacers at 6-in spacing were used in all testing. Slot widths of 1, 1.75, and 2.50 inches and slot lengths of 8, 24 and 48 ft were used. The tests at slot length of 8 and 24 ft were conducted to determine efficiencies over a range of flows. At 48 ft, testing was limited to total flow capture lengths. In order to cover a range of slope conditions, logitudinal slopes of 0.005, 0.02, and 0.09 were tested at cross slopes of 1/16, 1/32, and 1/64. Back slopes of 1/16 and 1/24 were tested at a curb distance of 15 in for all installations. All installations were also tested with the curb adjacent to the slot. A series of 4 or 5 discharges ws tested for each condition. For most field conditions weir flow controls the total capture length. Based on data from these studies, new equations were developed to cover a wider range of conditions. Back slope does not affect the partial flow interception efficiency in the range measured. (Moore-SRC)
W82-06095

CANALS IN SAND CHANNELS,
S. Kh. Abal'yants.
Hydrotechnical Construction, Vol 15, No 8, p 471-475, 1981. 1 Fig, 2 Tab, 19 Ref. Translated From Gidrotekhnicheskoe Stroitel'stvo, No 8, p 28-30, August, 1981.

Descriptors: *Canal design, *Mathematical studies, *Flow characteristics, *Hydraulics, *Channel flow, *Channel morphology, *Flow velocity, Canal construction, Design criteria, Stable channels, Canals, Flow friction, Mathematical equations, Roughness coefficient, Chezy equation, Sand, Canal linings, Channel erosion.

The mobility of material in a canal constructed in noncohesive sand soils is substantially affected by the turbulence of the flow, a factor not adequately reflected in the working formulas. Preliminary data indicates that Studenichnikov's formula for the critical velocity with a slightly reduced numerical coefficient and replacement of depth by the hydraulic radius without corrections for the channel shape is applicable for sands with a particle size to 1.5-2.0 mm. Equations were formulated establishing the existence of a stable quasihomogeneous flow whose conditions can be regarded as an expression of minimum energy dissipation. The influence of the roughness coefficient on the equations' parameters is discussed. Other factors such as traveling surges, wind and ship waves, local curves of the route, infiltration, nonuniform strength properties of the soils, and special conditions of the winter regime should also be considered when designing and constructing new canals. (Geiger-FRC)
W82-06196

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W82-06227

CAVITATION PROBLEMS IN HIGH-HEAD INSTALLATIONS (KAVITATIONSPROBLEME IN GRUNDABLASSEN).
Karlsruhe Univ. (Germany, F. R.). Inst. fuer Hydromechanick.
E. Naudascher.
Wasserwirtschaft, Vol 72, No 3, p 104-110, 1982. 14 Fig, 27 Ref. English Summary.

Descriptors: *Cavitation, *Design criteria, *Dams, Fluid mechanics, Erosion, Bottom outlets, Mathematical equations, Water currents, Vortices, Eddies, Flow, Turbulent flow, Aeration, Shear, Pakistan, *High-head installations.

The significance of cavitation for high-head installations was demonstrated by the collapse of a bottom outlet of the Tarbela Dam in Pakistan in 1974, which was caused by erosions of up to 5 m under the inlet structure and hollowing out of the piers. Damage from cavitation sets in principally when, in addition to the usual preconditions, vortex formations occur. Equations for calculating the cavitation figure (Ka), an estimate of the onset of cavitation, its extent and consequences, and for the size of Ka at the onset of cavitation (Ka krit) are given. Areas particularly susceptible to caviation are current boundaries with crooked edges or breaks. Shear zones form along the breaks in which turbulent vortices form. An equation to calculate Ka krit along smooth and rough walls and in free shear currents is given. Other conditions under which cavitation occurs are discussed. Design principles for avoiding cavitation are the streamlining of flow passages to keep pressure and velocity of the current within acceptable limits, the transfer of zones favoring cavitation to the inner areas of the current so that the walls are protected from erosion, and artificial aeration as well as the fostering of spontaneous aeration. Examples of all these principles are described and illustrated, and special protection measures and extraordinary operating conditions are discussed. Further research on the behavior of currents is called for. (Gish-FRC)
W82-06237

DESIGN FLOOD AND HYDROLOGICAL RISK FOR SPILLWAYS OR RESERVOIRS AND FLOOD PROTECTION BASINS (BEMESSUNGSHOCHWASSER UND HYDROLOGISCHES VERSAGENSRISIKO FUR TALSPERREN UND HOCHWASSERRUCKHALTEBECKEN),
Karlsruhe Univ. (Germany, F. R.). Inst. Wasserbau III.
E. J. Plate.
Wasserwirtschaft, Vol 72, No 3, p 91-97, 1982. 6 Fig, 14 Ref. English Summary.

Descriptors: *Design criteria, *Reservoirs, *Flood protection, *Dam failure, *Spillways, Floods, Flood control, Flood plain management, Risks, Reliability theory, Mathematical analysis, Design standards, Standards, Maximum probable floods, Hydraulic design, Reservoir design, Costs, Acceptable risk.

A concept for improving the design of spillways is presented, which can be used to supplement the rules of German Standard DIN 19700 for reservoirs and flood protection basins. The Standard is not far-reaching enough because its only design criterion is the probability of flood waters exceeding reservoir capacity, whereas the probability of dam overflow should also be considered, since there is no direct connection between the two. The first stage of the concept consists of calculating the overflow probability, which is also the probability of dam failure due to hydrological causes, by means of Freudenthal's reliability integral. The use of reliability theory leads to significantly longer recurrence intervals of overflow than those previously calculated. Sample calculations are given for a small potable-water reservoir, giving a recurrence interval of 34,528 years, and for a small flood protection basin, giving an interval of 642 years. Whether the small interval of the second example is significant or not depends on the damage that would be caused by overflow, and this leads to the second stage of the concept, that of acceptable risk. Rather than measuring total damage done by one flood, hydrological risk should be understood as a figure proportional to the expected value of damage expected per year following overflow. Methods of determining this are given, though as yet no concept exists to measure the acceptable level of non-monetary damage. This total concept can aid in economical design and help satisfy public demand for knowledge or risks to which they are subjected. (Baker-FRC)
W82-06238

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN).
Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
H. J. Hoch.
Wasserwirtschaft, Vol 72, No 3, p 110-114, 1982. 11 Fig, 6 Ref. English Summary.

Descriptors: *Jets, *Bottom outlets, *Gates, Model studies, Reservoirs, Plumes, Hydraulic design, Design criteria, Hydraulic engineering, Cavitation, Trails, Water currents, Tunnels, Irrigation, Irrigation engineering, *Sri Lanka, Rangenigala Reservoir.

Model studies were conducted to examine the confluence of jets behind two parallel segment gates in the bottom outlet of the Rangenigala Reservoir, Sri Lanka. The bottom outlet also functions as an irrigation outlet, which necessitated the construction of two gates at the end of the pressure tunnel for operational safety. The result of this is separation of flow by a dividing wall which for static reasons must be 2.6 m wide. Because of the high velocity (43.2 m/sec) of the two jets, which converged at a relatively large angle behind the wall, water plumes of up to 15 m in height ensued under certain conditions when an elliptical model wall was used. Theoretical calculations and reference to previous experiments led to a model in which pier width was kept constant at 2.6 m under the segment gates. Though the effect of jets crashing into each other when both gates were equally open and against the opposite channel wall when the gates were open at different levels was reduced by 70%, and a narrow plume of only 5 m in geight was formed, these conditions were not adequate to ensure the safety of the nonpressure tunnel. For this reason an extension to the wall was built, 35 m in length, with a height of 1.9 m at the wall, diminishing to 0.5 m. In this way the lower portion of the jet was channeled, while the upper portion gradually broadened out along the extending trail, and in the area of jet convergence water depth and Froude number were constantly changing. This trail was an improvement on previously built rails in that its side walls ran at an angle of 1 degree so that the flow cross-section of the jet broadened continuously, its form was prismatic to fix separation of flow along the edges, and it had a box profile to allow aeration of the trail end for the avoidance of cavitation. (Gish-FRC)
W82-06243

HYDRAULIC JUMP, AIR ENTRAINMENT AND SLUG FLOW IN BOTTOM OUTLETS (WECHSELSPRUNG, LUFTEINTRAG UND SCHWALLFORMIGER ABFLUSS IN GRUNDABLASSEN),
Technische Univ., Munich (Germany, F. R.). Versuchsanstalt Fuer Wasserbau.
J. Knauss.
Wasserwirtrschaft, Vol 72, No 3, p 115-119, 1982. 6 Fig, 1 Ref.

Descriptors: *Bottom outlets, *Air entrainment, *Hydraulic jump, *Closed-conduit flow, *Slug flow, Fluid mechanics, Flow, Flood protection, Vibrations, Supercritical inflow, Submerged outflow, Ventilation, Model studies, Design criteria, Hydraulic design, Hydraulic engineering, West Germany.

Conditions under which slug flow can occur and possible remedies for the situation are discussed with reference to operational installations planned for the flood protection basin at Schonstadt an der Itz, West Germany. Slug flow can arise in closed channels when submerged outflow conditions act on supercritical inflow so that a hydraulic jump fills the conduit. The consequences of this are dynamic stress reversals in the conduit, pulsating and discontinuous flow, and the danger of vibrations. Model studies showed that the planned positioning of the spillway and two bottom outlets close together on top of one another in a single casing under the dam would lead to slug flow due

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to a hydraulic jump entraining air within the conduit. Two remedies were possible, changing the outlet route or installing ventilation units to remove the entrained air. Because in this case air entrainment was unavoidable due to gate position and accumulation in the channel, it was decided to build two ventilation units in each bottom outlet. In this case the bottom outlets had an inclination of 5% and a cross-section of 2 x 2 m; the model studies also investigated channel inclinations of 3%, 6% and 12% with prismatic cross-sections of 20/15 cm (compact) and 20/30 cm (superelevated). Installation of ventilation systems may be avoided by designing bottom outlets with an appropriate vertical route for the channel to prevent accumulation. (Gish-FRC)
W82-06244

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1,
For primary bibliographic entry see Field 3F.
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,
For primary bibliographic entry see Field 3F.
W82-06376

CANADIAN WAVE CLIMATE STUDY: ORGANIZATION AND OPERATION,
J. R. Wilson, and W. F. Baird.
Marine Sciences and Information Directorate, Manuscript Report Series No 59, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 26 p, 9 Fig, 1 Tab, 31 Ref.

Descriptors: *Wave height, *Wave propagation, *Data collections, *Design criteria, *Breakwaters, Canada, Wave action, Wave crest, Wave direction, Waves, Kinematic waves, Wind waves, Buoys, Structural engineering, Port facilities, Histograms, Data acquisition, Data interpretation, Design standards, Sea walls.

The Canadian Wave Climate Study was established in 1968 to provide information to assist the design of marine facilities (e.g., deep water ports, breakwaters, offshore structures), and has led to wave data collections at about 200 locations in marine and inland waters on both the east and west coasts of Canada. Recent activities have led to the development of a standard analysis procedure and a set of data presentations useful to design engineering. These activities are delineated, along with the instrumentation employed, its reliability, and its operation characteristics. Specifically, the performance and calibration of the basic instrument employed, the waverider buoy, are described. Calibrations were carried out with a variable-speed mechanical oscillator capable of rotating a waverider in a fixed plane at a number of selectable fixed frequencies. Data control and analysis are discussed, and examples of data reporting products are given (e.g., scatter diagrams, peak-period histograms, wave height exceedence diagrams, wave height time-course plots, spectrum diagrams, surface elevation traces). In addition to the standard data products, wave data are available on magnetic tape in digital form in both computed spectral and surface elevation files (covering over 300,000 records in each of these files). (Zielinski-MAXIMA)
W82-06393

SEWER NETWORK ROUTING BY DYNAMIC WAVE CHARACTERISTICS,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
A. S. Sevuk, and B. C. Yen.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 379-398, March, 1982. 13 Fig, 3 Tab, 12 Ref.

Descriptors: *Routing, *Sewer hydraulics, *Wave action, *Flow characteristics, Unsteady flow, Simulation anlaysis, Mathematical models, Networks.

Although flow in storm sewer networks is usually unsteady, nonuniform, turbulent, and subject to mutual backwater effects of joining sewers, it is only recently that complete dynamic wave equations capable of accounting for the downstream backwater effect have been adopted in sewer network flow simulation. Numerical schemes for solving the dynamic wave equations are computationally costly and at times unstable. The Illinois Storm Sewer System Simulation Model uses the method of characteristics to solve these dynamic wave equations. The use of this model to route unsteady open-channel flow in dendritic sewer networks is reported. Application of the model to a 48-pipe sewer system confirmed the following characteristics of unsteady open-channel flow in sewer networks: the backwater effect of the junctions cannot be ignored in modeling these systems and, under certain circumstances, reversal flow may occur; the depth-discharge relationship is not unique and a loop-type rating curve exists; and the occurrence of maximum discharge in a sewer need not, and usually does not, coincide with maximum depth. The model is also applied to the example sewer network given in an American Society of Civil Engineers Manual of Engineering Practice in order to demonstrate how a dynamic wave routing model can be used to evaluate and improve a sewer system. Although several refinements to the model are desirable, the computed results of the model presented appear to be in good agreement with the expectations based on physical reasoning. (Carroll-FRC)
W82-06418

DILUTION ANALYSIS FOR UNIDIRECTIONAL DIFFUSERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 327-342, March, 1982. 9 Fig, 18 Ref.

Descriptors: *Diffusion coefficent, *Wastewater disposal, Cooling water, Mixing, Prediction, Mathematical studies, Powerplants, Design criteria, Flow discharge, Fluid mechanics.

Submerged multiport diffusers provide an efficient means for the rapid dilution of large volumes of wastewater discharged into ambient receiving waters. The mixing mechanics of two types of unidirectional diffusers used to discharge heated water from steam-electric powerplants into shallow, laterally unbounded receiving waters are examined. The diffusers analyzed include a coflowing diffuser, in which the discharge ports are oriented in the direction of the ambient current, and a tee diffuser, in which the discharge ports are oriented at right angles to the ambient current. An analytical theory for the dilution of a coflowing diffuser has been developed and was shown to yield good agreement with available measurements. Comparison of this theory with anlaysis governing other diffuser types indicated that the coflowing diffuser is the best choice for maximizing dilution in open receiving waters with predominant currents in one direction. The symmetrical orientation of a tee diffuser makes it the preferred choice over a coflowing diffuser when the receiving waters are characterized by weak bidirectional currents. A semi-empirical theory was used to illustrate the dependence of tee difusser dilution on ambient current speed, suggesting that the highest practical discharge velocity should be used to obtain the most efficient mixing with this type of diffuser. Comparison of dilution obtained with a tee diffuser with that expected for staged diffuser indicated that staged diffusers provide the best dilution for receiving waters with strong idirectional currents. (Carroll-FRC)
W82-06420

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,
Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W82-06422

ACCURACY CRITERIA IN DIFFUSION ROUTING,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, and F. D. Theurer.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 747-757, June, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Channel flow, *Flood routing, Muskingum model, Model studies, Routing, *Diffusion model, Hydrographs, Streamflow.

The Muskingum diffusion model, in which the channel routing parameters are calculated based on channel and grid characteristics, is evaluated. Numerical experiments are done to provide information on the criterion for spatial resolution to preserve the accuracy of the method. For very large values of the space step, unrealistic negative flows occur. The numerical experiments show that one of the routing coefficients, C2, should be equal to or greater than 0.33 for most practical applications. The upper limit for the space step can be calculated from an equation which includes the terms Courant length, characteristic reach length, and an accuracy parameter of 2. (Cassar-FRC)
W82-06423

THE V-SHAPED BROAD-CRESTED WEIR,
Waterloopkundig Lab., Delft (Netherlands).
W. Boiten, and R. H. Pitlo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 142-160, June, 1982. 18 Fig, 4 Tab, 15 Ref.

Descriptors: *Weirs, *Discharge measurement, *Crest gages, Hydraulic stuctures, Roughness coefficient, Flow measurement, Discharge coefficient, Flow velocity, Design criteria.

The V-shaped broad-crested weir, a widely used measuring structure in irrigation and hydrologic studies, was investigated to discover the influence of free flow and submerged flow with shape angles of 90, 120, and 150 degrees and to study the thickness of the boundary layer and its effects on the discharge coefficient. A horizontal broad-crested weir was used to study the influence of the crest material. The characteristic discharge coefficient was affected by three inteacting components: boundary layer effects related to crest roughness, lateral contraction upstream and downstream of the critical section Scaling effects may be caused by boundary layer effects if the Reynolds number is less than 300,000. The Froude number in the head measurement section should not exceed 0.2-0.5. The shape angle should not be less than 60 degrees. The modular limit for V-shaped broad-crested weirs is a submergence ratio of 80% if the ratio of the energy head tocrest length does not exceed 0.45. Above this value the modular limit is reduced. Submerged flow can be calculated by introducing a drowned flow reduction factor usable for submergence ratios of 80-93%. The structure is suitable for measuring small and moderate discharges. Rules for design and application are given. (Cassar-FRC)
W82-06450

TURBULENT FRICTION IN A VISCOUS SUBLAYER AND IN THE TRANSITION REGION OF THE FLOW OF WATER IN A FLAT DUCT,
Ye. S. Mikhaylova, and Ye. M. Khabakphasheva.
Fluid Mechanics-Soviet Research, Vol 9, No 6, p 37-51, November/December, 1980. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Turbulent flow, *Flow friction, Hydraulics, *Graphical methods, *Reynolds number, Flow, Flow measurement, Energy, Mathematical studies, Flow characteristics, Hydraulic properties, Flow velocity.

Reynolds stresses have been useful in studying turbulent energy in turbulent wall flow. In the present study, they are utilized in describing measurements in the central part of a flat duct with a

1:10 aspect ration (1 by 10 sq cm). The viscous sublayer and the zone of intensive turbuent energy generation (y(+) < or = 60) in immediate proximity to the wall were examined on a specially developed water loop apparatus. Within the viscous sublayer (y(+) < 5), turbulent shear stresses account for only a few percent of the total friction, whereas at y(+) > 30, viscous friction virtually ceases to have any effect. The effects of fluctuations in u' and v' of various signs and scales on turbulent friction are examined. The role of large fluctuations in turbulent transport of momentum within the viscous sublayer is greater than in the transition layer, where the strips of ordered flow break down at a high rate, while random mixing of the liquid takes place. Results are compared with previously recorded data on the structure of the viscous sublayer. (Geiger-FRC)
W82-06468

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,
For primary bibliographic entry see Field 8A.
W82-06500

SOLUTIONS OF THE COLEBROOK-WHITE FUNCTION FOR RESISTANCE TO UNIFORM TURBULENT FLOW,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
D. I. H. Barr.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 529-535, June, 1981. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Mathematical studies, *Reynolds number, *Turbulent flow, *Hydraulics, *Flow velocity, Mathematical equations, Flow characteristics, Flow, Model studies, Flow friction, Resistance.

For many years, less effective approximations for the Colebrook's smooth turbulent value of the Colebrook-White function approximation for resistance to uniform turbulent flow were widely used. The determination of the diameter when the discharge or the mean velocity is given is examined. Accuracy in approximating the Colebrook-White function requires the application of a correction factor to the smooth turbulent element of the approximation. Except when programmable calculators are applied to the intermittent solution of limited numbers of problems at a time, the conventional approach of iteration to attain a chosen limit of change in value between successive solutions is a wasteful process. A single accurate approximation solution is usually preferred, not only in the simple Colebrook-White function, but in developments for its use. The function may be combined with the Poiseuille equation for continuous laminar-turbulent coverage or used with generalization components to cover transition routes other than those delineated by the simple function. (Geiger-FRC)
W82-06501

NUMERICAL METHODS IN HYDRAULICS,
S. V. Voropaev, and V. M. Lyatkher.
Water Resources, Vol 8, No 3, p 225-226, May/June, 1981. Translated from Vodnye Resursy, No 3, p 32-33, May/June, 1981.

Descriptors: *Symposium, *Hydraulics, *Fluid mechanics, *Numerical analysis, Flow, Heat transfer, Mass transfer, Seepage, Waves, Flow around objects, Model studies, Mathematical models, Hydrodynamics.

The All-Union symposium on numerical methods in hydraulics was held on April 14-18, 1980, in Telavi, Georgian SSR. The symposium's main goal was to compare and analyze the results obtained on solving practical problems of hydraulics by numerical methods. Reports covered the following main subjects: flow around bodies and jet stream; free flows, waves on a water surface; flows in pressure systems; two- and three-dimensional problems of free flows; heat and mass transfer; and seepage. A trend toward the mutual concerns and merger of hydraulics and fluid mechanics was recognized. (Cassar-FRC)
W82-06614

HEREDITARY PHENOMENA IN TURBULENT BOUNDARY LAYERS,
Leningrad Polytechnic Inst. (USSR).
L. G. Loitsyanskii.
Water Resources, Vol 8 No 3 p 241-246, May/June, 1981. 5 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 52-59, May/June, 1981.

Descriptors: *Turbulent flow, *Flow velocity, *Boundary layers, Eddy viscosity, Boussinesq equations, Velocity, Flow characteristics, Numerical analysis, Hydrodynamics, Mathematical models, Model studies.

The Boussinesq formula and its modifications are suitable for use under the conditions of gradual variation of the mean velocity gradient, when the time scale of the variation considerably exceeds the time scale of turbulence. However, these equations do not give satisfactory results when the velocity varies abruptly on a small time scale compared to that of turbulence. Representations which reflect the prior history of the flow are required. This paper examines a general differential equation of transport devoid of local restrictions and a simplification proposed by Hinze and Builtjes, which accounts for the memory effect. Experimental data are compared with results obtained with various equations. (Cassar-FRC)
W82-06618

NUMERICAL METHOD OF SOLVING CERTAIN INVERSE PROBLEMS OF HYDRAULICS,
Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
A. F. Voevodin, and V. S. Nikiforovskaya.
Water Resources, Vol 8, No 3, p 288-292, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 114-118, May/June, 1981.

Descriptors: *Roughness coefficient, *Channel flow, *Flow characteristics, Water level, Unsteady flow, Steady flow, Numerical analysis, Hydraulic properties, Model studies, Mathematical models, Hydrodynamics.

A numerical method for identifying hydraulic parameters (roughness coefficient, coefficient of wind stress, etc.) from data of actual measurements of the level of the free surface or depth of flow is proposed. The flow of water in a channel is described by St. Venant equations. It is assumed that the flow is gradually varied and the identification parameters are constant over the entire length of the investigated reach of the channel. Two sample problems, in which the roughness coefficient is reconstructed, are given. The necessary accuracy in determining the water level is determined by an iterative process. (Cassar-FRC)
W82-06619

TURBULENT TWO-DIMENSIONAL FLOW OF AN INCOMPRESSIBLE FLUID AROUND OBSTACLES WITH SEPARATION,
Central Scientific Research Inst. of Aviation Engine Construction (USSR).
L. V. Gogish, and G. Y. Stepanov.
Water Resources, Vol 8, No 3, p 267-271, May/June, 1981. 3 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 85-90, May/June, 1981.

Descriptors: *Turbulent flow, *Flow around objects, *Flow separation, Numerical analysis, Hydrodynamics, Model studies, Mathematical models, Fluid flow, Hydraulics, Boundary layers, Flow velocity.

The integral method of calculation is the simplest and most reliable method of solving the problem of flow around obstacles with separation at high Reynolds numbers. The method uses empirical information about the general scheme of the flow, quasi-one-dimensional formulations of the problems for region of the layer and wake type, and the usual model of flow of an ideal fluid around a displacement body. Examples of calculating the velocity distribution in the case of turbulent flow around three types of objects (ledge, cylindrical segment projection, and a semicylinder, all located on a plane wall) are given. The complete solution of the problem of flow around an obstacle with separation contains five empirical coefficients. Three are concerned with the local conditions of the boundary-layer separation (increase in pressure, interaction length, and angle of deflection of the displacement body). Two characterize turbulent mixing in the near wake and in the isobaric bottom region. (Cassar-FRC)
W82-06621

INVESTIGATION OF THE TRANSFORMATION OF BREAKTHROUGH WAVES IN THE LOWER POOL OF A HYDROSTATION WITH THE USE OF COMPUTERS,
Georgian Scientific Research Inst. of Power and Hydraulic Structures (USSR).
G. N. Gvazava, L. L. Kvaratskheliya, and I. D. Muzaev.
Water Resources, Vol 8, No 3, p 304-307, May/June, 1981. 3 Fig, 5 Ref. Translated from Vodnye Resursy, No 3, p 135-138, May/June, 1981.

Descriptors: *Dam failure, *Wave propagation, Breakthrough waves, Numerical analysis, Model studies, Mathematical models, Hydraulics, Hydrodynamics, Computers.

The characteristics of the breakthrough waves formed by failure of dams and other water impounding structures were studied with a large-scale model and by numerical analysis. The test station was 1000 m long; channel width, 10-12 to 50-60 m; water volume in the upper pool, 550 cu m; and backwater height, 1.02 m. Two types of experiments were conducted: (1) instantaneous removal of the barrier and (2) blasting followed by breaks and washing away of the dam. The duration of collapse had little effect on the final results of the motion. Maximum depths of the breakthrough wave were the same; in the gradually collapsing situation maximum depths were delayed. Results of the numerical model agreed well with the observed results. Applying the numerical model to a high-head dam showed that collapse of a 100 m dam caused a breakthrough wave propagating at 30-35 m per sec, at which speed the air drag was a significant factor. Subsequently, the model was modified to account for air drag. (Cassar-FRC)
W82-06622

FINITE ELEMENT APPROXIMATIONS TO FLOW PROBLEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mathematics.
G. J. Fix.
Advances in Water Resources, Vol 5, No 1, p 17-20, March, 1982. 3 Fig, 7 Ref.

Descriptors: *Flow, *Finite element method, *Fluid flow, Fluid mechanics, Hydraulics.

Two sample problems using finite element methods to approximate fluid flows are illustrated. The first is a two-dimensional incompressible flow past an obstacle using the stream function and vorticity formulation. An appropriate variational method is developed using the classical Galerkin method. The second example is a three-dimensional incompressible flow using primative variables. The standard Galerkin method is also used, but it can only produce stable and accurate approximations with selected finite element spaces. The two necessary conditions are that the space of pressures must be related to the velocity space by a given equation and that the velocity space must satisfy a decomposition property analogous to the classical decomposition of a vector field into a curl free part and a divergence free part. (Cassar-FRC)
W82-06730

NUMERICAL INVESTIGATIONS OF PLANS OF FLOW IN CHANNELS WITH A COMPLEX BOTTOM RELIEF,

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All-Union Designing, Surveying and Surveying and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev, and S. Y. Shkol'nikov.
Water Resources, Vol 8, No 3, p 298-303, May/June, 1981. 3 ig, 9 Ref. Translated from Vodnye Resursy, No 3, p 126-134, May/June, 1981.

Descriptors: *Channel flow, *Flow pattern, *Roughness coefficient, Reservoirs, Flood plains, Numerical analysis, flow characteristics, Flow velocity, Bottom currents, Lower Kama Reservoir, cheboksary Reservoir, *USSR, Model studies, Mathematical models, Hydrodynamics.

Practical problems in channel flow were investigated by numerical modeling using two-dimensional St. Venant equations. Graphic representations of flow in fragments of reservoirs were obtained, allowing the region of interest, such as the inlet section, to be studied without having to calculate flows for the entire reservoir. To substantiate the use of the numerical method, results were compared with results from air pressure model experiments conducted on a 49.3 km reach of the Lower Kama Reservoir. This was partitioned into three fragments. The calculated and experimentally determined velocities agreed well, but the physical experiments detected some eddy regions absent from the calculations. The effects of roughness of the flood plain and channel were investigated for fragments of the Cheboksary Reservoir. In the first study the roughness coefficient of the flood plain was 0.07 and the roughness coefficient of the channel 0-0.07. In this case the channel roughness had little effect on the result; the flows generally followed the direction of the channel. In the second series of experiments the roughness coefficient of the channel was zero and of the flood plain, 0-0.1. For a flood plain roughness coefficient $>$ 0.02 the moduli of the velocity within the channel increased negligibly with increases in roughness coefficient and decreased on the flood plain. Velocity differences were $<$ 0.02, the character of the flow changed markedly and the jet going through reached the flood plain, forming eddies of different spatial scales. (Cassar-FRC)
W82-06785

EXPERIMENTAL INVESTIGATION OF ACCELERATED TRANSITIONAL FLOW IN PIPES,
Tallinn Polytechnic Inst. (USSR).
U. R. Liiv.
Water Resources, Vol 8, No 3, p 307-312, May/June, 1981. 6 Fig, 5 Ref. Translated from Vodyne Resursy, No 3, p 139-145, May/June, 1981.

Descriptors: *Pipe flow, *Transition flow, *Flow characteristics, Unsteady flow, Turbulent flow, Flow velocity, Velocity, Shear stress, Accelerated flow.

The distribution of velocity and intensity of turbulence over the cross section of a flow and the corresponding shear stress values at a pipe wall were studied during the replacement of one steady flow regime by another. The experimental device used a LISA hot wire anemometric apparatus with appropriate detectors for detecting the local characteristics of unsteady turbulent flow. Considerable changes occurred in the flow structure, expresses in deformation of velocity diagrams and in a change in the distribution of the relative intensity of turbulence. Shear occurred within the relative radius of 0.66-0.79, separating the flow into two parts, core and near-wall regions. Although the new level of turbulence was mainly generated in the near-wall region, the final flow characteristics were established more slowly than in the core. The core of the flow was more sensitive to changes in a pressure gradient between ends of the pipe. Eddy stresses were noticeable in the layers between core and near-wall regions during transition flows. (Cassar-FRC)
W82-06786

LOCATING MONITORING WELLS,
Wright-Pierce, Topsham, ME.
B. Caswell.
Water Well Journal, Vol 36, No 5, p 42-43, May, 1982.

Descriptors: *Well hydraulics, *Monitoring, *Path of pollutants, Seepage, Groundwater movement, Vertical flow, Flow velocity, Stratigraphy, Plumes, Geohydrology.

Monitoring wells are used to measure groundwater potentials and obtain water samples for chemical analysis. The hydrogeological factors involved in location of long-term monitoring wells are discussed. Monitoring wells must be located so that they intercept groundwater flowing either into or away from a contaminant source. Long well screens obtain integrated samples, and short screens obtain samples from a specific layer. It may be sufficient to estimate horizontal flow at the site by observation of local topography, but more detailed informaton from observation wells or seismic refraction data may be needed in some cases. Stratigraphy is important. Wells in sand are easy to locate, but wells in granite must be located in specific fractures. Clay layers may interfere with transmission of contaminants; the well screen must be placed in the layer to be monitored. Knowledge of vertical flow patterns is important because contaminants may be moved beneath a too-shallow well in a recharge area, or a too-deep well in a discharge area may intercept only upward moving uncontaminated water. Seepage velocity is important in determining the desirable distance between source and monitoring wells. Dispersion and the geometry of the slug or plume of contamination must also be considered in selecting number location of wells. The density of the contaminant will determine whether the substance will migrate downward and across normal groundwater flow lines. Existing aquifer stresses can alter flow directions and seepage velocities. (Cassar-FRC)
W82-06848

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and W. P. Bartlett, Jr.
Open-File Report 81-350, 1981. 13 p, 17 Feg, 1 Tab, 4 Ref.

Descriptors: *Bridge design, *Hydraulics, *Flood profiles, *Flood flow, Flood recurrence interval, Flood frequency, Flood discharge, Hydrologic data, *Ohio, Chillicothe, Paint Creek.

The Ohio Department of Transportation, Division of Highways, proposes to replace a three-span arch bridge across Paint Creek on South Paint Stree in Chillicothe, Ohio with a new deck-type structure resting on four sets of piles and four piers. Profiles of the 10-, 25-, 50-, and 100-year floods under present conditions and under conditions modified by construction of the new bridge are presented in this report. The results indicate that the construction of the new bridge will not cause significant changes in the flood profiles or the areas inundated. (USGS)
W82-06948

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,
Science and Education Administration, Fort Collins, CO.
R. E. Smith, D. L. Chery, Jr., K. G. Renard, and W. R. Gwinn.
Technical Bulletin No 1655, July, 1982. 70 p, 43 Fig, 3 Tab, 12 Ref, 4 Append.

Descriptors: *Flumes, *Sediment load, *Discharge measurement, Open channel, Flow discharge, Rapid flow, Velocity, Sediment transport, Supercritical flow flume.

High natural velocities and sediment concentrations in many locations prohibit the use of ordinary subcritical flow flumes because these flumes require such low approach velocities that sediment is deposited. Supercritical flumes have been developed to provide flow measurement for conditions of heavy sediment where ordinary flumes do not perform satisfactorily. A general type of supercritical flow flume, called the Walnut Gulch flume, has been developed over many years of experience and testing in discharge measurements at the Walnut Gulch experimental watershed, Tombstone, Arizona. Methods have been developed to analyze flows that exhibit lateral asymmetry in cross sectional profile, and porous dikes have been developed to considerably reduce asymmetry in the alluvial approach section to these flumes. The experience with the Walnut Gulch flumes has led to an improved design of supercritical flume, called the Santa Rita flume. The flume was intended for use in small channel flow measurement, generally less than 4 cu m/s. The slope of the floor breaks at the entrance to the curved approach, and the curvature of the approach wall has been reduced somewhat to decrease the tendency of waves to develop in the throat when flow direction changes too rapidly. (Moore-SRC)
W82-06959

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. I. Vikulova, O. N. Shishova, and E. A. Selivanova.
Water Resources, Vol 8, No 4, p 389-397, July/August, 1981. 6 Fig, 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 4, p 91-102, July/August, 1981.

Descriptors: *Sediment transport, *Canals, *Sand, *Canal embankments, Deformation, Channel erosion, Channel morphology, Erosion, Unstable channels, Bank erosion, Open-channel flow, Channel flow, Flow velocity, Rivers, Dunes, Shoals, Flumes.

Deformation of canals in sand was studied in a 20 x 4 x 1 m flume formed from sand. Several conclusions were reached. Transverse transport of sediment along troughs of underwater sand dunes is an important factor in the channel formation process. The transport of sediment from the banks along the troughs of oblique dunes causes slope instability, eventually widening the channel. Transverse sediment transport within the channel distributes suspended sediment over the entire width of the channel and promotes formation of large bed forms. The two stages of channel development are (1) initial (the channel widens, shoals, loses capacity, and develops transverse dunes, which cause bowing of the flow), and (2) transition (formation of large bed formations as are seen in rivers). The third stage could not be modeled in the laboratory because vegetation is a major factor. The formation of shoals and secondary dunes occurs at constant water discharge. The rate of widening of the channel is dependent on current velocity. (Cassar-FRC)
W82-06990

8C. Hydraulic Machinery

RESONANT WATERHAMMER: A CASE STUDY,
Empresas Publicas, Medellin (Colombia).
H. Perez.
International Water Power and Dam Construction, Vol 34, No 4, p 42-43, April, 1982. 1 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Maintenance, Electric power, Powerplants, Electric power production, Water supply development, Water resources development, Valves, *Waterhammers.

A description is offered of a case of resonant waterhammer on a 270 MW, 550 m gross head project in Colombia. Pressure fluctuation measurements are included and the remedial measures taken to safeguard the installations. The water supply system consists of a 160 meter long tunnel and two penstocks. The total length of the pipes is quite small to cover the height difference between the valve house and the powerplant. Two butterfly valves are provided to control the flow, one at the upstream end of each of the penstocks and six spherical ones at the downstream end, just before the entrance to the scroll case of each of the turbines. The first stage of the project came into operation in 1962. and the second stage in 1965/66. Resonance has occurred on two occasions. After

the phenomenon was studied, it was concluded that typical self-excited resonance had taken place, and that the only element which could have caused the problem was the spherical valve. After a while the conditions for penstock-valve vibration and pressure oscillation of the hydraulic system were tracked down, and the phenomenon could be reproduced at will. Resonance occurred on penstock 1 if the needle valves of units 1 and 2 were open, and a complete shutdown of the system was carried out independently of which one of the units 1 to 6 was taken out of operation. Resonance occurred during a complete outage, though with lower intensity if the needle valves of either 1 or 2 were open. Resonance was noted in penstock 1 and the spherical valve of the unit of which the needle valves were open. No resonance occurred if units 3 to 6 were in operation and units 1 and 2 were stopped, regardless of whether the needle valves of these units were left open or not. (Baker-FRC)
W82-05981

SIMULATING AND IMPROVING HYDRO PLANT CONTROL,
Bochum Univ. (Germany, F.R.). Dept. of Mechanical Engineering.
K. H. Fasol, and M. Hoppe.
International Water Power and Dam Construction, Vol 34, No 5, p 73-78, May, 1982. 6 Fig, 13 Ref.

Descriptors: *Hydroelectric plants, *Control systems, *Simulation analysis, Turbines, Computers, Model studies, Flow regulation.

Analog simulation of a small hydro station with two 40 MW Francis turbines was carried out to provide information on the dynamic performance of the plant. As a result as additional stabilizing compensating circuit was designed, tested by simulation, and then tested in a prototype version. Field tests of frequency response and isolatd network operations confirmed the reliabiity of the simulation. The problem facing this station was the lack of a surge tank within the 6 km long water supply tunnel. Only very small rates of change in the guidevane opening were permitted before instability was reached. (Cassar-FRC)
W82-06202

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),
Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
M. Horster, S. Rabben, and G. Rouve.
Wasserwirtschaft, Vol 72, No 3, p 157-159, 1982. 6 Fig, 3 Ref. English Summary.

Descriptors: *Aeration, *Bottom outlets, *Dams, *High-velocity jets, Floor offsets, Cavitation, Velocity, Energy transfer, Reservoirs, *Gates, *Tunnels, Design criteria, Water pressure, Hydraulic engineering.

Bottom outlet tunnels usually have a very large cross-section due to a small energy gradient drop during operation. The main gate can be placed either at the beginning of the outlet or in the middle of the tunnel. In both cases the gate is the critical transition from pressure to nonpressure flow, where potential energy is transformed into kinetic energy and the question of adequate aeration from above arises. This question can be avoided by placing the gate at the end of the tunnel. The tunnel floor should then be curved in the direction of flow and should be furnished with a connecting offset. In this way, high velocity jets discharging below the gate can be aerated from below as well as naturally from above. Cavitation is also prevented because in the area of the concave curve, pressure forces arise that exceed by far the static pressure. (Gish-FRC).
W82-06242

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN).
Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8B.
W82-06243

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,
North-West Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-06258

DESIGN OF HEAT PUMP RETURN WELLS,
Michigan Dept. of Public Health, Lansing.
D. K. Keech.
Water Well Journal, Vol 36, No 6, p 32-33, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wells, *Design criteria, *Heat pumps, Return wells, Groundwater recharge, Artificial recharge, Recharge, Induced infiltration.

A return well for groundwater heat pumps must be isolated from possible sources of pollution as required by various state or local codes. Construction of the return well should be equal in materials and workmanship to that of a production well and also meet all construction code requirements for the area. In Michigan a clamp-on type of pitless adapter is generally used as the frostproof casing connection to the well. Pressurization of gaskets is a requirement for approval of this design and is important from a public health standpoint on either a production or a return well. Pressurization of the discharge line also has a practical value in preventing water from draining from the drop pipe. It is recommended that 10 psi of pressure be maintained on the line between the heat pump and return well. The back pressure valve must be calibrated to meet the head pressures caused by the static water level for each individual return well. The water level in a return well is elevated in order to apply the higher head that is needed to transmit the water into the aquifer. The specific capacity should be compared to the proposed rate of discharge into the return well. A return well with a specific capacity greater than 1 gpm/ft of drawdown will generally indicate a usable return well, providing the static water level is at a depth of 20 to 25 feet below ground level. One modification which may improve a marginal return well or aid wells with a higher static head is the use of a drawdown seal. (Baker-FRC)
W82-06294

DESIGN CONSIDERATIONS IN WATERWORKS PUMPS SELECTION,
McGraw-Edison Co., N.Y.
W. C. Krutzsch.
In: Water/Engineering and Management, Reference Handbook-1982, p 40-43, May, 1982. 3 Fig, 4 Tab.

Descriptors: *Water treatment facilities, *Pumps, Design criteria, Wastewater facilities, Cavitation.

To ensure the selection of pumps which will provide maximum efficiency, it is necessary to consider specific speed. It has been estblished that the most efficient pumps are those having specific speeds falling in a range of about 2,000 to 2,500. Values below 1,500 are seldom acceptable for networks applications except where the pumps are small and power requirements low. For any given combination of capacity and head, specific speed is directly proportional to pump speed, and higher values of the former can be achieved only by increasing the latter. This situation is unacceptable because the net positive suction head required (NPSHR) of the pump at higher speeds cannot be provided by the system. Pump performance will be unsatisfactory due to cavitation, with resulting noise, vibration, and possibly serious damage to the impeller and to other pump components as well. Recirculation will develop independently at the impeller inlet and outlet as capacity is reduced, most frequently at different capacities for each of these regions. Its cause is inherent in the nature of the centrifugal pump and the uses to which it is put. High specific speed pumps are less suited to waterworks services than optimum specific speed designs. They are most susceptible to recirculation and tend to have more limited operating ranges. The beneficial effects of increased NPSHR on the operating range of a pump can only be realized if the pump manufacturer can take advantage of it. While economic advantages of high specific speed pumps are often publicized, their disadvantages must be noted, and may not become apparent until after installation, making it a costly process. (Baker-FRC)
W82-06343

VARIABLE FREQUENCY DRIVES - SOME APPLICATION PRINCIPLES,
Robicon Corporation, Pittsburgh, PA.
R. N. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 55-56, 58-60, May, 1982. 5 Fig.

Descriptors: *Water treatment facilities, *Design criteria, Energy conservation, Wastewater treatment, Pumps, Hydraulic engineering, Hydraulic design, Hydraulic equipment.

A review of one of the major energy saving potentials typical of the water treatment industry is offered. Use of a variable speed drive can accomplish reduced flow conditions by slowing down the speed of the pump impeller, allowing the motor pump combination to deliver the lower flow at a lower head. With many centrifugal pumps, this means of reduction will require horsepower input proportional to the speed cubed. It is the substitution of variable speed of the prime mover for throttling or bypass of a portion of the pumped fluid to accomplish flow modulation that is the basic idea and will bring about energy savings to the industry. If a system will operate with a control valve to maintain flow at 80% or less for 25% of its operating time, the economies of a variable speed drive for centrifugal machinery should be investigated. If a system is operating with a variable speed drive at 80% flow or less for 50% of its operating time, substitution of a more efficient solid state drive should be investigated. Employment of a variable frequency drive will provide a secondary benefit for the starting of the motor. By using a variable-frequency drive to start the motor, breakdown torque as a limit is available on starting rather than locked-rotor and pull-up torque. This will prove useful to hydraulic engineers confronted with severe limitations of a power system. Other applications include high pressure fans, blowers or compressors used to introduce air to increase oxygen content. (Baker-FRC)
W82-06345

PUMP SUMP DESIGN EXPERIENCE: SUMMARY,
Engineering Hydraulics, Inc., Longmont, CO.
C. E. Sweeney, R. A. Elder, and D. Hay.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 361-377, March, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Design criteria, *Sumps, *Pumps, Hydraulic models, Performance evaluation, Flow characteristics, Hydraulic machinery, Cooling water, Vibration, Model studies.

The capacity of vertical mixed flow pumps used to provide cooling water for industrial purposes and power generation has been increasing in recent years. However, since the thickness of the casing wall and the rigidity of the support do not increase in the same proportion as the hydrodynamic loading on the pump, larger pumps are more susceptible to vibration and rough running and better entrance flow conditions are needed to ensure satisfactory performance. The conditions of flow entering a pump are the net result of approach flow to, and the hydraulic design of, the sump in which the pump is operated. Hydraulic conditions which may result in pump performance problems, standards currently used in sump design, and criteria used to judge the acceptability of sump designs on the basis of the performance of hydraulic models are discussed. The designs of seven wet well sumps

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for vertical mixed flow pumps modified through hydraulic mode tests are presented and compared with design standards currently in use. Although currently published standards for basic sump dimensions provide a good starting point, modifications are needed to achieve satisfactory hydraulic performance by large pumps. Performance criteria used in the development of the existing standards may not have been as stringent as those required for current large capacity pumps. A variety of suggestions for sump modifications and dimensions are presented which may provide a basis for developing conceptual or trial designs for sumps for large capacity pumps. A hydraulic model study should be performed when designing any major pumping facility to assure satisfactory performance. (Carroll-FRC)
W82-06419

SWIFT ACTION BY STATE OFFICIALS PREPARES FOR WATER SUPPLY CRISIS.
Public Works, Vol 113, No 3, p 64-65, March, 1982.

Descriptors: *Water transfer, *Water supply, *Pumping plants, New York, New Jersey, Drought, Pipelines, Water shortage.

New Jersey installed a 20 mgd temporary, portable 24 inch water main across the George Washington Bridge, to supply water to the drought-stricken northeast section of the state in 1981. The source of the water was the upper Delaware River, from which New Jersey had not previously used its full allotment. A permanent pumping station was built in an unused tunnel at 179th and Amsterdam Avenue, New York. Suitable pumps, which normally require months to fabricate, were diverted from shipment to a petroleum company in the Southwest. The pump and pipeline system is available for use in water emergencies and can be dismantled and stored in years of adequate rainfall. (Cassar-FRC)
W82-06514

ZIMBABWEAN HAND PUMP PASSES VILLAGE-LEVEL ENDURANCE TESTS.
Water Water, Vol 5, No 5, p 36-37, May, 1982.

Descriptors: *Pumps, *Developing countries, Rural areas, Wells, Water supply, *Zimbabwe.

The low cost, rugged Blair/Prodorite hand water pump, developed in Zimbabwe, appears to fulfill the criteria for a village level operation and maintenance pump. Costing $75 in kit form, the pump is made of lightweight plastic. Only the galvanized iron pump handle, which doubles as the water spout, is visible above ground. Below ground the pump consists of two plastic cylinders, one inside the other, fitted with identical valves at the base. The inner pipe is the piston/push rod. The upstroke draws water into the cylinder through the lower fixed foot valve. The downstroke closes the foot valve and forces water up the hollow portion to the surface. The pump is usable to depths up to 15 m. It lifts 20 liters per min, and 30-40 strokes by a young person can fill a bucket. Installation requires only the simplest tools and little technical expertise. Maintenance is confined to occasional clearing of debris from the foot value. In a factory test the pump was continuously pumped for 6 million strokes (90 years of use for a single family) with no detectable wear. (Cassar-FRC)
W82-06606

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),
H. Brombach.
Wasserwirtschaft, Vol 72, No 2, p 44-52, February, 1982. 6 Fig, 1 Tab, 17 Ref. English Summary.

Descriptors: *Control systems, *Storm-overflow sewers, *Storm wastewater, *Hydraulic equipment, Wastewater facilities, Wastewater treatment, Valves, Flow control, Flow characteristics, Hydraulic engineering, Decision making, Planning, West Germany.

Various controllers for stormwater treatment plants are discussed in terms of performance and suitability for different types of facility. Pipe throttles are the most common type of controller in the West German sewage system, though they are not easily adapted to differences in quality and quantity of flow. The throttle slide valve is suitable for stormwater overflows and purification basins due to its low height and space requirements, large discharge, and subquadratic discharge pattern. Vortex throttles can significantly undercut the minimum discharge of the pipe throttle and are especially useful for small stormwater basins. The automatic vortex valve has roughly the same discharge span as the vortex throttle but is safer during operation; it is suited to storm overflow basins because it switches on less often and later than other controllers and produces its own short flushing surges. The float flap with nonlinear kinematics is well suited to stormwater overflow basins and flood protection basins, while the closed-loop controller (a hybrid using both electromechanical and hydraulic energy) is employed exclusively in exposed stormwater basins. The stop-and-go controller is used for stormwater basins with outflow of < 10 l/sec, because continuous control provides too small a sweeping force and too great a risk of blockage. A complex diagram to aid in the choice of a controller is presented, as is a method for installing a cortex valve. A five-step plan for controller strategy for a serial system of overflow basins is described. Transition to automatic systems is presented in the form of a three-stage plan. (Gish-FRC)
W82-06633

PUT PRESSURE ON SEWAGE,
Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 5D.
W82-06732

8D. Soil Mechanics

THE VALUE OF INSPECTION GALLERIES,
Lahmeyer International G.m.b.H., Frankfurt am main (Germany, F. R.).
C. Kutzner.
International Water Power and Dam Construction, Vol 34, No 5, p 78-84, May, 1982. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Inspection galleries, *Dam design, *Seepage control, Earth dams, Rockfill dams, Grouting, Drainage systems, Dam foundations, Foundation rocks.

Inspection galleries, also known as grouting galleries, inspection tunnels, drainage galleries, or control galleries, are often built inside or below dams. This paper discusses the advantages of inspection galleries in earth and rockfill dams. Seepage monitoring and control can be readily accomplished by piezometers installed in the inspection gallery. Release holes for preventing or reducing uplift below the downstream dam body can be readily drilled from the gallery. Underground settlement and displacements can be monitored from the gallery. Grouting work can be performed from the gallery without disturbing the embankment filling process. If necessary, grouting can also be done after impoundment. The negative aspects of galleries include extra costs and the possibility of disturbing foundation rock. Design and construction details for inspection galleries are given. (Cassar-FRC)
W82-06204

THE GROSSE DHUNN DAM AND THE FACILITIES FOR THE CONTROL OF STABILITY AND FUNCTIONING (DIE GROSSE DHUNNTALSPERRE UND DIE MESSEINRICHTUNGEN ZUR UBERWACHUNG DER STANDSICHERHEIT UND DER FUNKTIONSTUCHTIGKEIT DES DAMMES),
Talsperrenabteilung des Wupperverbandes (Germany, F. R.).
F. Cords.
Wasserwirtschaft, Vol 72, No 3, p 119-123, 1982. 9 Fig, 1 Tab, 2 Ref. English Summary.

Descriptors: *Dams, *Measuring instruments, *Rockfill dams, *Dam construction, Hydraulic engineering, Drinking water, Reservoirs, Water resources development, Water supply, Soil mechanics, Seepage, Safety, *West Germany, Grosse Dhunn Dam.

The Wupperverband constructed the Grosse Dhunn Dam 10 km east of Leverkusen, West Germany, to ensure an adequate drinking water supply for the Bergisches Land to the year 2000 and beyond. This is a rockfill dam (built 1979-1980) with bituminous core sealing and a grout curtain (finished in 1981) with double rows to 25 m and single row to 50 m under foundation level. The dam is 63 m high, 380 m long, and 8.5 m wide. Its capacity is 81 cu hm. The planning, subsurface exploration, construction, and installation of measurement and control equipment is described. The rockfill-type dam was chosen as esthetically pleasing in the given landscape. Soil mechanics studies resulted in the bituminous core being bent toward the air side in the upper third and in the division of the dam cross-section into core zones with fill of small rocks and outer zones where less sealing was required. Particular care was taken to perform quality control on the bituminous core, as after installation this can no longer be inspected. Numerous measurement points were installed to observe all movement and sealing properties of the dam during and after construction. External deformations could be detected by above-ground measurement points at five dam cross-sections, while internal deformations could be measured on the air side by a shaft lying along the third above-ground cross-section. Techniques applied were leveling, angle measurement, electrooptical distance measurement and optical sounding in the shaft. Tension measurement was also performed. To control the sealing properties, the transition zone on the air side of the bituminous core was constructed of coarse ballast without fill to allow for seepage. (Gish-FRC)
W82-06240

TEST AND CONTROL PROGRAMME FOR TWISTE DAM SITUATED IN SANDSTONE AND WITH RESTRICTED EXTENT OF SUBSURFACE SEALING (MESS- UND UBERWACHUNGSPROGRAMM EINER STAUANLAGE IM BUNTSANDSTEIN BEI BEGRENZTER UNTERGRUNDABDICHTUNG AM BEISPIEL DER TWISTETALSPERRE),
G. Bjornsen.
Wasserwirtschaft, Vol 72, No 3, p 135-139, February, 1982. 6 Fig, 4 Ref. English Summary.

Descriptors: *Dam design, Geology, *Sandstones, *Soil mechanics, *Rockfill dams, *Groundwater movement, *Sealing, Safety, Design criteria, Dam construction, Dams, Hydraulic engineering, Twiste Dam, *West Germany, Seepage, Permeability, Drainage, Testing procedures.

Geological conditions at the site of the Twiste Dam, West Germany, are unfavorable. The dam is situated in new red sandstone, and the valley gravel and sides and the underlying rock are permeable. Groundwater streams are forced to change direction around the dam shoulders and into a neighboring valley. The dam itself is permeable, as it is filled with new red sandstone, but water pressure is reduced by the carpet of river clay on the valley floor and by weathered rock on its sides. Soil mechanics and projections of groundwater flow under and around the dam by means of potential theory determined the dam design. The fill was compressed in layers to reduce permeability, and a trench-furrows drainage system was built on the air side embankment to lessen possible negative effects of compression on the surface filter. Because of the soft plastic clay foundation, the dam was built very wide with a flat embankment; to improve the watertightness of the clay, additional clay sealing and compression of the basin floor were performed. Reduction of water flow around the dam was achieved by extension of the injection curtain about 20 m beyond the shoulder. A five-year test program, during which the dam was filled to capacity in stages, confirmed the theoretical model and led to the introduction of additional

safety measures. For example, meadows below the dam became waterlogged and a drainage system was constructed; seepage into the neighboring valley necessitated an extension of the valley-side sealing to the height of greatest operating capacity. The program demonstrated the importance of separate geohydraulic systems: on the one hand, bank prefilling, valley-side permeability and trench-furrowed drains; on the other, basin sealing, rock foundation, dam, and surface drains. The influence of anisotropy should be taken into account at the planning stage. (Gish-FRC)
W82-06632

8E. Rock Mechanics and Geology

INVESTIGATIONS FOR NORWAY'S LONGEST UNLINED PRESSURE SHAFT,
Geoteam A/S, Oslo (Norway).
J. Bergh-Christensen, and R. Kjelberg.
International Water Power and Dam Construction, Vol 34, No 4, p 31-35, April, 1982. 9 Fig, 2 Tab, 3 Ref.

Descriptors: *Excavation, Water resources development, *Norway, Construction, Stability, Mathematical studies, Computers, Model studies, Design criteria, Geological surveys, Tunnels.

An unlined pressure shaft is described which will sustain the highest water pressure in Norway, and probably in the world. The geology of the site is described, along with studies undertaken to determine the design criteria. The pressure shaft is 1130 meters long, with a static head of about 1000 m. The topography of the sites is complex, and the main part of the scheme is at an evaluation varying between 1000 and 1200 meters, where the terrain is mountainous and rugged. From the reservoir the water is fed through a headrace tunnel to the top of the pressure shaft at an altitude of 800 meters. The pressure shaft itself will have an inclination of 45 degrees, with its lower end just inside the powerplant. The method used for evaluation of the shaft siting is based on a calculation of total stresses by finite element plain strain analysis. The main condition imposed by this approach is that the minimum total stress should be higher than the water pressure at every point along the shaft, to avoid the risk of failure by hydraulic fracturing. The computer program used gives, for this type of finite-element analysis, the stress distribution along a vertical plane normal to the contour lines of the terrain model. The shaft has to be located, in this case, obliquely in relation to the valley side, and consequently the standard program does not give the complete stress distribution along the shaft in a single run. The results of the model studies indicated that the maximum total stress was mainly parallel to the valley side. The preliminary location of the shaft should be sufficiently safe, from these studies, and this location was chosen for the final site. (Baker-FRC)
W82-05980

DESIGNING AND EXCAVATING UNDERGROUND POWERPLANTS,
Trondheim Univ. (Norway). Dept. of Geology.
E. Broch.
International Water Power and Dam Construction, Vol 34, No 4, p 19-25, April, 1982. 8 Fig, 8 Ref.

Descriptors: *Powerplants, *Design criteria, Construction, Tunnels, *Underground structures, Stability analysis, *Norway, Geologic fractures, Geology.

Norwegian experience in the field of underground powerhouses is reported, noting that about half the world's underground stations are located in that country. Until recently the conventional drill and blast technique has been the dominating method of excavation. Approximately two thirds of the country consists of Precambrian rocks, with different types of gneisses dominating. Other major rock types from this era include granites, gebbros and quartzites. There are also provinces dominated by arkosic sandstones and shales. Norwegian bedrock is very old and, from an engineering geological point of view, one could describe it as a typical hard-rock province. With knowledge of geological conditions, a geological engineer may give advice so that construction problems for an underground opening in rock may be avoided or solved in an economical way. Geological conditions include the types of rocks and the mechanical properties of each, the jointing of the rock masses, the weakness zones of the bedrock, stress conditions in the rock masses and the water conditions in the rock masses. The most important part of a feasibility study for an underground opening is to find the right place and position. Certain unfavorable types of rock should be avoided. Soapstones, serpentinites and periodotites together with jointed tectonites with clay coated joints and fissures have caused severe stability problems in underground openings. Considerations for the orientation of the long axis of the powerhouse, shaping of underground openings, dimensioning of underground openings, and design considerations for unlined shafts and tunnels are discussed. (Baker-FRC)
W82-05982

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),
H. Breth.
Wasserwirtschaft, Vol 72, No 3, p 152-157, 1982. 15 Fig. English Summary.

Descriptors: *Powerplants, *Weirs, *Subsoil, *Erosion, Hydroelectric plants, Erosion control, Geologic mapping, Geologic formations, Sealants, Silt, Dams, Water resources development, Filters, Screens, Drau River, *Austria, Control systems, Seepage control, Design criteria, Hydraulic engineering.

The power station Annabrucke and the accompanying weir were constructed on the River Drau in Austria on a subsoil endangered by erosion. The subsoil is composed of very permeable river gravel under which a layer of semi-permeable silt of varying thickness is found; within the latter, sands and occasional pockets of gravel occur caused by the steep angle of these strata. Under the main barrage and turbine and weir outlets lies the largest pocket of gravel containing dangerous inlays of uniform-sized grains. In order to use the silt layer as a sealing element, the power station and weir, as well as the two dams adjoining them on either side were joined to the silt layer by a sealing screen. The braking effect of the silt meant that seepage water would flow through the three-level surface filter behind the main structure into the bottom water almost without pressure. A further louvered slide was built behind the surface filter to cut of the uniform grain layers and force groundwater through the filter. An electrical analogy model confirmed the sealing and braking concept. The decision to build a power-station complex on such a foundation requires extensive site investigation using numerous bores to construct a model as well as a thorough observation system so that runoff can be controlled not only under the main structure but also under the basin and dams bordering the basin, behind the dams and in the bottom water under the main structure. A year after operation began, measurements showed that the braking effect of the silt and the draining effect of the uniform-grain layers ensured that seepage was dissipated before it reached the turbine and weir outlets so that the danger of erosion in the susceptible layers was eliminated. (Gish-FRC)
W82-06636

INVESTIGATION OF THE PARAMETERS OF WAVES ON A RESERVOIR SURFACE IN THE EPICENTRAL ZONE OF AN EARTHQUAKE,
Akademiya Nauk URSR, Kiev. Inst. of Hydromechanics.
B. N. Ostroverkh.
Water Resources, Vol 8, No 3, p 282-288, May/June, 1981. 4 Fig, 4 Ref. Translated for Vodnye Resursy, No 3, p 105-113, May/June, 1981.

Descriptors: *Reserviours, *Earthquakes, *Wave propagation, *Oscillatory waves, Mthematical models, Seismic waves, Model studies, Numerical analysis, Wave height, Rock mechanics.

The effect of earth quake zone parameters on surface waves in reservoirs was investigated using a numerical model to vary depth of the zone, rate of dislocation diffusion, remoteness from the epicenter, and the direction of tangent stresses along the displacement walls of the fissure. Figures showed the value of the maximum displacement of the water (the wave height) as a finction of: (1) the distance of the earthquake focus and (2) the depth of focus. Modeling results indicated that consideration of the combined oscillations of the elastic region and fluid region had a negligible effect on the oscillations of the elastic region, i.e., the oscillations of the surface of the wet and dry bottom were not significantly different from one another. However, it was necessary to consider the residual deformations of the bottom, formed in the case of a shallow-focus earthquake.(Cassar-FRC)
W82-06783

8F. Concrete

WORLD'S FIRST ALL-ROLLCRETE DAM,
Army Engineer District, Walla Walla, WA. North Pacific Div.
E. K. Schrader.
Civil Engineering (New York), Vol 52, No 4, p 45-48, April, 1982. 2 Fig.

Descriptors: *Dams, *Construction materials, Construction, Design criteria, Water resources development, Water supply, *Concrete, Oregon.

The use of roller-compacted concrete was explored in the construction of a 400,000 cubic yard of concrete by more than two-thirds. Willow Creek Dam will be the world's first gravity dam to be built entirely with roller compacted concrete. Other such dams are now under construction. By using this method, Willow Creek Dam will be built with 75% less material than was required for the originally designed rockfill structure. The dam will be built in about one year instead of the three years previously planned. The spectacular savings in both time and money are due to the lower cement content required and the substitution of efficient earthmoving equipment and techniques for the far more labor intensive bucket-by-bucket procedure for placing conventional concrete. One of the main advantages of the design at Willow Creek was the elimination of a separate side channel spillway otherwise required for a rockfil or embankment dam. (Baker-FRC)
W82-05999

MIX DESIGN PARAMETERS FOR CONCRETE CONTAINING CHEMICAL ADMIXTURES,
E. L. Ore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237082. Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-81-6, December 1981. 27 p, 12 Fig, 5 Tab. 0-07-DV-00109.

Descriptors: *Concrete additives, *Concrete technology, *Concrete mixes, Compressive strength, Cements, Temperature effects, Aging, Setting time, Water-cement ratio.

Concrete samples having water to cement ratios ranging from 0.35 to 0.65 with various quantities of WRA (water-reducing and set-controlling admixtures) ranging from 0.00 to 0.40% at three temperatures were prepared and periodically tested at intervals up to 1 year. An average quality aggregate was used to provide adequately conservative concrete design data. The effect was evaluated for each condition of WRA on the rate of hardening at early ages, as shown by the resistance to penetrate of the wet-screened mortar, and at extended aging, as shown by the compressive strength. The larger dosages of WRA generally resulted in lower water requirements; however concrete with 0.10% WRA required slightly more water than the reference

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concrete. From 21 to 32 C, the water requirement increased 4.5% for each 5.5 degree temperature change. The setting time of mortar, wet-screened from concrete, increased as the WRA dosage increased. Larger amounts of WRA resulted in 1-day compressive strengths which were lower than the reference concrete, but by 3 days all concrete samples with WRA were stronger than the reference concrete. All concretes containing WRA were stronger than those without WRA except for the 0.40% WRA concrete where the 1-day strengths were slightly less. The use of WRA's was most effective in concrete with lower water-cement ratios and higher temperatures. A comparison of concretes with equal 28-day strengths but different water-cement ratios showed that the concrete without WRA was stronger at 90 days and 1 year than that with WRA. (Moore-SRC)
W82-06397

WATER TANKS IN REINFORCED CONCRETE,
Norwest Holst Construction Ltd., Watford (Englandd).
W. M. Pedder.
Water Services, Vol 86, No 1033, p 117-119, March, 1982. 2 Fig, 1 Tab.

Descriptors: *Concrete construction, *Water tanks, Reinforced concrete, Water storage, Design criteria, Joints.

Reinforced concrete water storage tanks are commonly constructed in pairs, buried and landscaped for esthetic reasons. A typical design is 2 tanks each 25 m square, 4.5 m deep. Each tank roof is covered with gravel for grainage and soil for a grass cover. Expansion joints are not usually required up to about 70 m length. Columns to support the roof are conveniently spaced on a 4.8 m square grid. All vertical wall joints, except corners, and internal movement joints should be full contraction joints. Roof joints are partial contraction joints. Metal or polyvinyl chloride water bars and sealant are usually provided at all joints. Details for design of walls and roof slabs are given. (Cassar-FRC)
W82-06604

8G. Materials

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,
Massachusetts Univ., Amherst. Dept of Chemistry.
For primary bibliographic entry see Field 5F.
W82-06051

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,
Mobil Oil A.G., Celle (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W82-06120

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMIDICHTUNGEN),
By H. Steffen.
Wasserwirtschaft, Vol 72, No 3, p 144-147, 1982. 3 Fig, 3 Ref. English Summary.

Descriptors: *Sealants, *Dams, *Errors, *Design criteria, Core seals, Surface seals, Materials, Hydraulic engineering, Stress, Seepage, Erosion, Construction, Stress, Construction joints, Expansion.

The installation of sealing in dams is discussed with emphasis on the interaction between the sealing and transition materials, foundation and support structures. For surface sealing, the foundation should be laid so that as little movement as possible occurs through consolidation, or transition materials should be chosen that allow the sealing to move in the direction of the expected stress. Copper is preferable to plastic where the transition material must carry high water pressure. Common errors are failure to place an expansion joint in the area where movement is expected or a too-massive construction of the transition joint. Plastic materials are more susceptible to erosion. Core sealing may experience fission forces if distortions occur in the supporting structure; these may lead to seepage and erosion. Distortion of the core is another cause of damage. For asphalt cores, transition zones are recommended. Quality control of the sealing during and after installation is important: for core sealing, an area may be singled out as a test zone, and test cores should be extracted from the main core; the success of surface sealing can be determined by isotope sounding. Four examples of sealing errors are given: a too-porous material was used in the first-ever bituminous core seal, and led to permeability; in an asphalt membrane seal a tear above the joint led to slippage of the shear stress of the seal away from the joint, which caused a tear; a too-large joint in an asphalt seal caused a lack of give with expansion stress and let to the seal separating from the dam; and a tear occurred between strips of plastic sealing, allowing water to flow into the dam. None of these failures presented a danger to dam security, due to well-planned design and inspection measures. (Gish-FRC)
W82-06241

SEWERAGE: PRIORITIES FOR ACTION,
Water Research Center (England).
D. Fiddes, and M. J. Rouse.
Water Pollution Control, Vol 81, No 2, p 280-287, 1982. 12 Ref.

Descriptors: *Sewer systems, *Rehabilitation, Maintenance, Structural engineering, Physical properties, Construction materials, Hydraulic profiles.

This paper considers both the structural and hydraulic problems involved in planning proper sewage transport and treatment and suggests priorities for action by the industry. Evidence for the scale of sewer dereliction in the United Kingdom is collected from two sources: collapse and sample surveys. Data collection has been a major problem, as historic data were scarce. A collapse is defined as any sewer failure where excavation is required to effect the repair. The UK collapse rate appears to be about 5000 incidents per year. The current collapse rate would suggest a mean service life for the current sewer population of about 1000 years. Evidence from closed circuit television surveys shows that after reaching about 70 years of age, brick sewers deteriorate rapidly. The amount of money spent annually to rehabilitate sewers in rsponse to collapse incidents roughly equates to the estimated expenditures on all sewerage rehabilitation. It may therefore be concluded that very little planned renewal is being undertaken. Work is currently underway to divide the existing sewer system into three zones - Zone A will contain the dewers where rapid detrioration has a high probability, Zone B will have less frequent surveys and only gross defects will be dealt with, and zone C will have maintenance only in response to incidents. Assessment of the hydraulic performance of sewerage systems is even more difficult. The lack of analysis techniques and the known presence of many unrecorded storm overflows together with the transient and infrequent occurrence of flood-producing rainfall make it inevitable that many of the older sewer systems are also performing indifferently in the hydraulic sense. (Baker-FRC)
W82-06260

ADVANCED COATINGS FOR THE WATER INDUSTRY.
Water Services, Vol 86, No 1033, p 124-125, March, 1982.

Descriptors: *Coatings, *Corrosion control, *Water tanks, Waterproofing, Plastics.

Several protective coatings for use in the water industry are described. They waterproof but are generally vapor permeable. Decadex, for external tank use, is solar reflective. It protects stone, brick, concrete, slate, wood, and tile from water, weather, and most chemicals by a seamless application. Steridex, a fungistatic protective finish, is used in drinking water plants. Sterepel not only is fungistatic, it also kills insects and rodents. Firecheck is a flameproof coating. Isoclad protects metal structures from rust and salt spray attack. Soladex is an elastomeric solvent-based high-build barrier coating which protects a wide range of substrates from water penetration and corrosion. It is ideal for use in low temperature areas. These products are manufactured by Liquid Plastics Limited, Preston, England. (Cassar-FRC)
W82-06603

CROSS-COUNTRY FORCE MAIN.
Water/Engineerig and Management, Vol 129, No 7, p 47-48, June, 1982.

Descriptors: *Pipelines, *Wastewater disposal, *Plastics, Force mains, Hortonville, *Wisconsin, Polyethylene.

A $370,000 12 inch diameter high density polyethylene force main buried 7-9.5 ft deep carries wastewater effluent from the Hortonville, Wisconsin, treatment plant to the river 2.5 miles away. The route was chosen to bypass the town and reduce costs of digging up streets. A wildlife marsh was located only 50 ft from the plant, but effluent discharge there was not allowed without expensive tertiary treatment. Pipe sections were joined by heat fusion to form an essentially continuous conveyance, except for planned air release and access points. The flexible pipe is expected to perform well in the shifting, corrosive soil. (Cassar-FRC)
W82-06640

STATUS OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
R. Field, H. Masters, and M. Singer.
Water Research, Vol 16, No 6, p 849-858, June, 1982. 11 Fig, 1 Tab, 8 Ref.

Descriptors: *Paving, *Porosity, *Infiltration, Storm runoff, Water pollution sources, Aquifer recharge, Flood control, Water pollution control.

The Porous Pavement Research Program of the Environmental Protection Agency is discussed, including information on the economics, advantages, potential applications, and status and future research needs of porous pavements. Such pavements are an available stormwater management technique which can be used on parking lots and low volume roadways to reduce both stormwater runoff volume and pollution. In addition, groundwater recharge is enhanced. Also, cost reductions result due to elimination of curbs, drains, and small sized storm sewers. Porous asphalt pavements consist of a relatively thin course of open graded asphalt mix over a deep base of large size crushed stones. Water can be stored in the crushed stone base until it can percolate into the subbase or drain laterally. Other porous pavement types include concrete lattice blocks and a porous concrete mix. If the possibility exists that water infiltrating the ground could reach a water supply aquifer, adequate protective means should be undertaken to determine that the surface runoff is not still contaminated when it reaches the aquifer. (Baker-FRC)
W82-06665

8H. Rapid Excavation

PRACTICAL CALCULATIONS AND RECOMMENDATIONS ON THE USE OF GUNPOWDER ROCK BREAKERS IN HYDROTECHNICAL CONSTRUCTION,
N. Ya. Orlov.
Hydrotechnical Construction, Vol 15, No 8, p 502-506, 1981. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stov, No 8, p 51-53, August, 1981.

Descriptors: *Rock excavation, *Hydraulic equipment, *Hydraulic properties, *Mathematical analysis, *Hydraulic engineering, Hydraulic design,

Equations, Hydraulic geometry, Rock properties, Strength, Explosives, Gundpower Rock Breakers.

The effectiveness of gunpowder rock breakers in fracturing old foundations and structures depends largely on the parameters of the hydraulic pulse. Fracture of the medium is possible where the maximum pressure in the pulse is > or = to the compressive strength strength of the medium. Equations are given to analyze the water-hammer phenomenon that occurs in the compressive phase of the pulse and determines the processes of dynamic compression of the fluid with interference of the shock waves and without outflow of the fluid into cracks. These take into account the design of the rock breaker, the geometry of the shothole, and the physical properties of the medium. They show that the elastic volume in the area of the anchor device greatly affects the reflection of the incident waves and slows the pressure increase in the pulse. The half-phases of the annular section and of the perforated part of the tube are important in attaining maximum pulse amplitude, and the inertia of the annular section is influential in shaping the pulse. Equations for measuring cracks occurring at the end of the compression phase and for determining the duration of the discharge phase are also given. Finally, calculations are given for fracturing a mass by means of several rock breakers acting simultaneously. (Gish-FRC)
W82-06086

8I. Fisheries Engineering

NOTES ON THE CONSTRUCTION, INSTALLATION AND ENVIRONMENTAL EFFECTS OF HABITAT IMPROVEMENT STRUCTURES IN A SMALL LOWLAND RIVER IN SHROPSHIRE,
Liverpool Univ. (England). Dept. of Zoology.
S. Swales.
Fisheries Management, Vol 13, No 1, p 1-10, 1982. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Aquatic habitats, *Dams, *Deflection, *Fish management, Water depth, Habitats, Perry River, England, Turbulent flow, Channel improvement, Riffles, Flow velocity, Water currents.

Fish Habitat improvement structures were placed in the River Perry, a small lowland river in England, The channel had been dredged and widened on several occasions since 1900 to improve drainage conditions. In a 600 m reach two low dams (< 1 m high) and two current deflectors were installed. One deflector was put in a shallow fast-flowing area and the other in a deeper slow-flowing section. A floating plywood artificial cover was added to simulate overhanging bank vegetation and undercut banks. The dams increased water depth and reduced current velocity above the impoundment and decreased water depth and increased current velocity (maximum 80 cm per sec) downstream. Below the dams the greatly increased water turbulence scoured bed material, producing a pool and ripple pattern. Both current deflectors increased flow velocity (maximum 60 cm per sec) by narrowing the river channel, but only the one installed in the shallower, fast-flowing part of the river produced a pool-ripple pattern. The temporary covers effectively simulated natural cover but were damaged by winter floods. (Cassar-FRC)
W82-06084

HYDROACOUSTIC ASSESSMENT OF PELAGIC FISH STOCKS: A POTENTIAL NEW MANAGEMENT TOOL,
Vermont Univ., Burlington.
G. W. LaBar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256660, Price codes: AXX in paper copy, A01 in microfiche. Report, February, 1981. 35 p, 23 Fig, 4 Tab, 2 Ref. OWRT A-037-VT(1).

Descriptors: *Sonar, *Sound waves, *Fish populations, *Remote sensing, *Trawling, Fathometers, Sounding, Water depth, Aquatic populations, Populations, Aquatic life, Fisheries, Marine environment, Technology, Commercial fishing, Fish harvest, Aquatic animals, Fish, Smelt, Biomass, Aquatic productivity, Fish management, Acoustics.

Hydroacoustic assessment, a tool for employing sonar to assess fish area populations in fisheries and the marine environment, is receiving increased attention. Studies were carried out to develop a method of analyzing echograms employing echo density and variability concepts, to compare mean echo densities on echograms with catches from a midwater trawl and to compare echograms from various Lake Champlain sites at various time periods. Specifically, a dot-grid was used for analysis of echo density on the echograms in an attempt to determine relative abundance of pelagic fish. Highest echo-densities were generally noted between 60-100 feet. While significant echo count differences were found between depths, between Lake sites, and between times, no real pattern of echo count differences emerged. Correlation coefficients relating midwater trawl smelt catch numbers to mean echo counts at trawling depth were -0.02 for large (45 ft square mouth) and 0.37 for small (16 ft square mouth) trawls. However, the relationship between echo counts and biomass is unknown. While a combination of echo sounding needed before other standard assessment techniques can be eliminated. The method developed herein, however, has been demonstrated to Vermont fish and game personnel. (Zielinski-MAXIMA)
W82-06373

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
F. B. Lotspeich, and F. H. Everest.
Forest Service Research Note PNW-369, January 1981. 11 p, 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Gravel, *Spawning gravel, Streambeds, *Sediment sampler, *Aquatic habitats, Larval growth stage, Permeability, Pore size.

Textural composition of spawning gravel influences survival and emergence of salmonid embryos. A new method has been developed for collecting, sorting, and interpreting gravel quality. Because both sediment distribution and redd site selection by salmonids are nonrandom events, the location from which samples are drawn should be identified by an experienced fishery biologist. Samples are collected with a tri-tube freeze-core device and dry-sorted using sieves based on the Wentworth scale. An index to the quality of gravel is obtained by dividing geometric mean particle size by the sorting coefficient (a measure of the distribution of grain sizes) of a sample. The resulting number is called the 'fredle index' and is proposed as a standard for evaluating the reproductive potential of spawning gravel. The magnitude of fredle numbers is a measure of both pore size and relative permeability, both of which increase as the index number becomes larger. Permeability and pore size control movement of water and alevins through gravel. This method of calculating a quality index for stream sediments allows identification of the quality of gravel used for reproduction by salmonids. Comparisons can be made of gravel quality within and between strams, and temporal changes in texture and permeability can be monitored. The technique should be especially useful for measuring changes in gravel quality resulting from sedimentation from nonpoint sources in managed forest watersheds. (Moore-SRC)
W82-06395

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 7B.
W82-06703

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-06985

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH SUPPORT PROGRAM 1981 - 1982.
Department of the Environment, Ottawa (Ontario).
1981. 12p, English and French.

Descriptors: Water resources, *Research projects, Inland waters, Universities, Quality, Pollutants, Modelling, Contamination, Hydraulics, Data collections, *Canada.

The Department of the Environment, on the recommendation of the Water Resources Research Support Program Review Group, has agreed to provide a total of $250,000 for water-related environmental research during 1981-81 to the Canadian university research community. The Water Resources Research Support Program provides for innovative research relevant to departmental concerns and responsibilities for water resources research in the natural and social sciences with emphasis on water management issues. By fostering the interest of university researchers, it thereby utilizes their knowledge and expertise in solving water research problems and provides opportunities for their participation in socially relevant environmental research. Fifteen universities across Canada will share the $250,000, which will be used to support both unidisciplinary research projects and multi- or interdisciplinary programs aimed at solving regional and national water research issues. (WATDOC)
W82-06565

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

FRESHWATER MACROINVERTEBRATES,
National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W82-06797

ELECTROPLATING AND CYANIDE WASTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06798

STEEL INDUSTRY WASTES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5D.
W82-06799

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W82-06800

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06801

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COAL AND COAL MINE DRAINAGE,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5B.
W82-06802

EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Research Lab. Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-06804

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5D.
W82-06805

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W82-06806

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
For primary bibliographic entry see Field 5C.
W82-06808

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5C.
W82-06809

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, NV.
For primary bibliographic entry see Field 5A.
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